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Association of Lean Implementation on Perceived Organizational Maturity Levels of Managers and Staff in the Public Sector

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ASSOCIATION OF LEAN IMPLEMENTATION ON PERCEIVED ORGANIZATIONAL MATURITY LEVELS OF MANAGERS AND STAFF IN THE PUBLIC SECTOR

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ABSTRACT

Extensive research has shown the impact of Lean implementation at the process level of an organization to increase quality, reduce cycle time, and reduce operational costs. However, little research has been done to associate Lean with improvement at the strategic level of an organization. The objectives of the present research were to (a) study the association of Lean implementation with maturity levels of employees (b) study the relationship between Lean implementation in the levels of agreement with cohesion between managers and staff in evaluating perceived current state and desired state of organizational practices (c) identify potential barriers of Lean implementation that may affect the establishment of a culture of continuous improvement. The research took place in two different departments within the Office of Public Health (OPH) of Louisiana that were classified as Lean and Non-Lean. A total of 53 participants volunteered to participate in the study (25 Non-Lean and 28 Lean), and 46 were used in the analysis. The Government Lean Self-Assessment Tool (GLESAT) was used to assess the level of maturity and identify gap scores between managers and staff. The assessment consisted of 55 practices divided into three main sections: 1) enterprise leadership 2) lifecycle and enabling processes 3) enabling infrastructure. The overall scores of the Lean group were significantly higher than the Non-Lean group by 41.18% for the current state and 13.53% for the desired state. However, Gap scores between managers and staff did not differ significantly between Lean and Non-Lean groups for either perceived current state or desired state of organizational practices. In terms of barriers of Lean implementation, participants identified lack of management support, lack of training, lack of communication, lack of strategy, poor organizational culture of improvement, employee resistance and understaffing as the main problems faced in the organization. In conclusion, Lean implementation can be associated with higher perceived organizational maturity of employees. Good organizational maturity is crucial in the development and support of a transformation plan, where the organization

understands its current performance and strengths so further plans can be developed to improve the organization's weaknesses. However, results of the present study showed that Lean does not affect the levels of cohesion between managers and staff in evaluating perceived current state and desired state of organizational practices.

1 INTRODUCTION

Managers in the public sector play a critical role in the way that services are provided to the public and have to make sure that taxpayer funds are spent in an effective and efficient manner (Schiele & McCue, 2011). Managers seeking to improve the way services are delivered and to be more cost effective need to focus their attention on systems where there is a considerable amount of cost incurred and significant opportunities for process improvement exist (Miller, 2009). Some process improvement methods or techniques have been transferred from the private sector to the public sector given their considerable success. Methodologies such Six Sigma, Balanced Scorecard, benchmarking and Lean have been implemented in the public sector bringing positive results to the organization in terms of quantitative and qualitative outcomes (Holzer, Charbonneau, & Kim, 2009; Radnor, 2010). However, it is important to be careful when trying to transfer methodologies from the private to public sector given that management-labor relations in the public sector are based on different principles and laws than those in the private sector (Scorsone, 2005).

Lean techniques and tools have been growing in popularity across public sector leaders looking to improve their systems. Lean has been shown to improve public services and to transform them positively (Bhatia & Drew, 2006). Lean has been successfully applied in a range of areas in the public sector from hospital management to accounts payable processes in local governments (Waterman & McCue, 2012). Lean can be used in the public sector to improve the quality of the service delivered to customers and value for money spent on the process (Schiele & McCue, 2011).

Lean is defined as a philosophy that functions as a guide to increase quality, reduce costs, and increase satisfaction of staff and customers by implementing a set of tools and techniques that serve different purposes in particular areas or circumstances of the process (Radnor, 2010; Waterman & McCue, 2012). However, the success of these continuous improvement changes is not only related to

their substantial nature or content but also to the process undertaken prior and during their implementation (Armenakis & Bedeian, 1999). Therefore, there are some conditions that need to be in place to make the change happen and achieve a continuous long term effect. Readiness to change or the level of organizational maturity is considered one of the most important conditions (Armenakis, 1993).

Organizational maturity is the collective awareness of members of an organization towards the existence and the source of a problem in the organization and the full support of solutions to solve it (Smelser, 1951). The level of maturity can be reflected in the organization members' attitudes, intentions and beliefs towards whether changes are really needed and the organization's capacity to accomplish those changes (Armenakis, 1993). Drew, McCallum, and Roggenhofer (2004) discussed how behaviors of management and members of an organization can affect the process of change and highlighted the importance of this mindset and behavior to achieve successful Lean transformation. The implications of overlooking organizational maturity may be that an appropriate intervention doesn't produce the intended organization changes because its members were not ready (Armenakis, 1993). In order to successfully implement and sustain Lean in the long term, organizations need to develop a cultural system focused on the customer where any action taken is focused on improving the effectiveness of the goods or services delivered where key leaders work with other employees to support all the initiatives in a consistent way throughout all levels of the organization(Carlino & Flinchbaugh, 2005).

The success of continuous improvement initiatives require commitment throughout the organization where top managers as well as the rest of the members involved in the process need to share similar values and understand the need for change and embrace it. Most case studies of implementing Lean in the public sector reflect outcomes on process improvement and cost reduction (Furterer & Elshennawy, 2005; Waterman & McCue, 2012). However, there is no substantial data to

conclude if the implementation of Lean is associated with the level of maturity and shared values of the employees.

1.1. Research Objective

The purpose of this research is to identify whether Lean implementation is associated to the levels of perceived current organizational maturity and desired Lean state in an organization. In addition, the present research aims to identify if there is a significant gap between managers and staff in their perceived level of current organizational maturity and desired Lean state that may affect negatively in their performance and implementation process of Lean. More specifically, the objectives of the study are:

1. Identify whether Lean implementation increases the level of perceived current organizational maturity and desired Lean state
2. To identify the existence of significant gaps in the level of perceived current organizational maturity and desired Lean state between managers and staff in the public sector.
3. To analyze whether the implementation of Lean tools and initiatives is associated with a reduction in the gap of perceived organizational maturity level and desired Lean state of the organization.
4. To identify barriers and enablers in the implementation of Lean tools and initiatives in the public sector.

1.2. Scope

This study compared the levels of perceived current organizational maturity level and desired Lean state of a public sector program between managers and critical staff. The research consisted of a survey intended to be a self-assessment of the perceived present state and the desired state of the program to determine the extent to which Lean principles, practices, and behavior have become parts of

the organization. The results of the survey were used to identify a possible gap between them that may affect the performance of the program and the association of Lean initiatives on those gaps. In addition, this study aims to identify possible barriers and enablers that may affect the implementation of Lean initiatives.

The study was performed in two different programs within the Office of Public Health (OPH). Each program was categorized as being in one of two Lean levels: Non-Lean and Lean. The study assessed a total of 53 participants. Participants included program functional management levels including program executive leadership, directors, office management and non-managerial employees that are critical in the process of implementing improvement initiatives.

1.3. Significance

The current research investigates the association of Lean implementation with the levels of perceived current organizational maturity and desired Lean state of a program between managers and staff. This research will develop a better understanding of the association of Lean implementation in the levels of agreement and cohesion between managers and staff in evaluating perceived current state and desired state of organizational practices. Moreover, the present research presents barriers of Lean implementation identified by the participants.

2 LITERATURE REVIEW

Lean has rapidly gained popularity as a process management philosophy in both private and public administrative and service organizations (Jorgensen, Matthiesen, Nielsen, & Johansen, 2007). Lean provides opportunities to improve processes by reducing waste and service time while enhancing quality (Womack & Jones, 2003). In addition, successful Lean implementation brings opportunities for a positive and fulfilling working environment for employees due to their involvement and ownership in improving current processes and developing new ones (Womack, Jones, & Roos, 1990) . However, the implementation of Lean is not always a positive experience for the employees (Carter et al., 2011; Harrison, 1997) due to bad management approaches and the high degree of standardization of the work functions associated with Lean (Jorgensen et al., 2007). These causes may increase resistance among employees that impedes the sustainability of Lean in the long term. The goals of implementing Lean initiatives should not only be the improvement of current processes but also the introduction of cultural change that helps to increase the understanding of critical processes and to streamline the values and priorities of all organization members towards achieving a shared goal. Undertaking organizational assessments can help change agents to make specific choices about proper strategies needed to help foster employee enthusiasm for improvement initiatives to avoid such resistance.

This literature review discusses the association of Lean implementation with the perceived organizational maturity of managers and staff in the public sector. The first section provides an introduction of the public sector to understand their need for improvement and some characteristics that shape their organizational culture. Then, an overview of Lean including its origin, expansion to other industries, benefits at the process and strategic level of an organization, and barriers and facilitating factors during Lean implementation is presented. Moreover, a section discussing the expansion of Lean to the public sector is reviewed. The last section introduces the role of assessment in

Lean transformation. A review of different Lean assessment tools that have been used in other studies is presented to select the most appropriate tool for the present research.

2.1 Public Sector: The Need for Improvement and Problems Faced

Governments have the responsibility to provide good quality services such as education, healthcare, and transportation to its people. These services require enormous funds to support the infrastructure needed, which in many cases is not enough to meet the expectations of delivering good quality service. This forces governments to reduce the workforce and cut some programs to be able to keep others available. However, the funds saved taking those measures may not be enough or may deteriorate the quality of service provided by the public institution. The need to improve the value for money spent at all levels of public sector organizations is an important issue that is always under discussion (Bhatia & Drew, 2006).

Public sector organizations are continuously subjected to external pressures such as fiscal stress, market value changes, new government policies and the expectation of improved government services that demand a need for change in the way services are delivered (Schiele & McCue, 2011; Zhonghua & Ye, 2012). Public managers looking to cause a positive impact in terms of quality and cost reduction of services need to focus on areas where there is a significant amount of operational cost incurred and possibilities for process improvement (Schiele & McCue, 2011). Public sector organizations can learn from the private sector to find suitable methods that improve the cost and quality of services delivered (Zhonghua & Ye, 2012). Unfortunately, public sector organizations face a number of factors that make improvement of their performance difficult in distinction to their private sector counterpart. While private organizations are owned by entrepreneurs, public organizations are agencies owned by the government and funded with public funds (Lan & Rainey, 1992). Also, public sector organizations typically have different stakeholders including politicians, government administrators, and the public

that demand different goals that are potentially conflicting with those of the organization itself (Boyne, 2002). This reflects in employees facing high scrutiny through continuous reviews and external audits by the stakeholders looking for indications of mismanagement of public funds. In turn, this creates an environment that makes those involved in the process focus more in procedural compliance instead of value for money spent (Schiele & McCue, 2011). The high amount of rules and procedures required to be followed affects the efficiency of the organization by increasing the complexity of performing tasks that would otherwise be considered as simple (Schiele & McCue, 2011; Thai, 2001).

In sum, it is important to note that public and private organizations differ in a variety of different aspects and the understanding of these characteristics can be critical for the success of new improvement initiatives. The following section highlights the most important characteristics of public sector organizations that contrast with their private sector counterpart.

2.2 Organizational Culture of the Public Sector

Although failure of planned organizational change may be due to many factors, few are so critical as employees' attitudes towards the change event (Jones, Jimmieson, & Griffiths, 2005). Employees' attitude towards change is shaped in the most part by the culture of the organization (Jordan, Lindsay, & Schraeder, 2012). Although there is no clear consensus of what defines organizational culture, many authors agree that the culture of an organization is defined by its values, goals, structure, and environment (Boyne, 2002; Jones et al., 2005). Identifying these characteristics of an organization is critical in the process of implementing change initiatives as they provide insight of the readiness to change of the organization. Boyne (2002) identified four main categories of theoretical effects of "publicness" that influence how the basic functions of management are carried out in the public sector. These categories are classified as:

1. Organizational environment
2. Organizational goals
3. Organizational structures
4. Organizational values

2.2.1 Organizational Environment

Public organizations are complex systems that operate through networks of interdependent organizations that place their own demands and constraints on managers (Boyne, 2002). When the goals between stakeholders are different, their requirements are likely to be conflicting (Hardy & Phillips, 1998). In addition, public organizations are constantly under political pressure to achieve quick results before the political cycle in order to receive an equal or larger share of resources in the next round of appropriations (Bozeman & Kingsley, 1998). The potential problem with this is that most government executives or elected officials didn't join government to manage. For instance, they may not care about processes and are driven by a desire to advance a policy issue or a political agenda (Miller, 2009). This means that politicians normally get excited and focus on creating new bold programs to solve existing problems instead of improving current existing programs.

Another characteristic of the public sector is that there is typically little to no competition in the provision of services by the public sector. Boyne (2002) explains that even if there is competition, public institutions have a dominant position in the market against its competitors (e.g., education and health care in certain countries). Dixit reports that most public service organizations can be considered monopolies, which results in poor quality service at a high cost of operation (Dixit, 2002).

Lastly, another factor that influences the environment is the high level of scrutiny in the public sector. Jordan et al. (2012) explain that the public sector faces high levels of scrutiny from the public,

along with the increase in the expectations of conduct that embody honesty, fairness and responsiveness.

2.2.2 Organizational Goals

One of the most frequent observations about public organizations' goals is that they are multiple, hard to measure, intangible, and in many situations conflicting (Lan & Rainey, 1992). Public organizations need to satisfy the goals imposed by their multiple stakeholders making unclear what direction the organization needs to take. For instance, it is important that public managers balance and integrate conflicting objectives (Boyne, 2002).

Goals in the public sector may be unclear or ambiguous to those within the organization. Lan and Rainey (1992) report that compared to private managers, public managers perceive the goals of the organization as less clear and less easy to measure. For instance, if the manager perceives the goals to be unclear and hard to measure, it is expected that they have an unclear perception of the efficiency of the organization. This frequently happens because the purpose of the organization is appointed through political processes instead of being selected by managers themselves (Boyne, 2002).

2.2.3 Organizational Structures

Organizations in the public sector have generally very formal and rigid procedures for decision making, creating a less flexible and risk averse system than their counterparts in the private sector (Bozeman & Kingsley, 1998; Lan & Rainey, 1992). In terms of operating practices / procedures, public sector organizations are often characterized as being mechanistic, infused with ancient traditions, rules, policies and protocol (Jordan et al., 2012) . These characteristics create a complex environment based on bureaucratic processes that involve a high service cost, low productivity, and decrease of organizational commitment in the organization (Boyne, 2002). In addition, the culture of the organization becomes a "culture of fear" where the employees are not willing to innovate with new

methods or strategies to make the organization more efficient in an attempt to avoid conflict (Boyne, 2002; Bozeman & Kingsley, 1998; Hilger, 2010).

2.2.4 Organizational Values

A main difference between public and private sector could be attributed to the values shared by the people of the organization. These values concern the aspirations and attitudes of their staff towards work and life in general (Boyne, 2002). Public servers are believed to be less materialistic and have a stronger vocation to serve the public than their counterpart in the private sector. Bright (2009) pointed out in his study that workers in the public sector tend to be less motivated by monetary incentives than their counterpart in the private sector. Bright (2009) expands saying that workers in the public sector may join the organization for several reasons such as following the same ideal, or trying to cause an impact in society.

2.3 Lean Background

The term "Lean" or "Lean production" was first used by Womack et al. (1990) in "The machine that changed the world". However, its principles were developed by Taiichi Ohno at Toyota Motor Company in the 1950s. Ohno characterized the key objectives of the Toyota production system (Lean) through two key principles: continuous improvement (efficiency through the elimination of waste) and respect for the workers (Emiliani, 2006). The International Motor Vehicle Program defines Lean as a philosophy which when implemented, reduces the time from which the client made the order until you supplied, eliminating sources of waste in the production flow (Sanjay & Peter, 2006). There is abundant literature that validates the success in the implementation of Lean techniques (Barton & Delbridge, 2006; Cagliano, Caniato, & Spina, 2006; Melton, 2005; Taj, 2005; Tsung-Ming & Chao-Ton, 2007). Lean Manufacturing is often associated with benefits such as inventory reduction, reduction of manufacturing time, increase in quality, flexibility and customer satisfaction (Taj, 2005). In a Lean state a perfect

workflow is achieved by getting the right things, at the right time, and in the right quantity while minimizing any process waste and maintaining flexibility for future process improvements or ability to change (Womack et al., 1990). Womack and Jones (2003) summarized Lean into five principles that enable the organization to do more with less effort, equipment, time, and space while getting closer to provide customers with exactly what they want.:

1. **Identify Value -**Specify value from the customers' viewpoint so they can be provided with exactly what they want.
2. **Identification of value stream** - Identify all steps in the value stream and eliminate every step, which does not create value.
3. **Flow** - Make the remaining value-creating steps occur in a tight and integrated sequence so the product will flow smoothly toward the customer.
4. **Pull** –Produce no good or service until it is demanded by a customer
5. **Perfection** - Pursue perfection through continuous improvement.

Lean is more than a box of tools that can use to solve a problem. Instead, it needs to be applied as a philosophy by which the organization is based to create a desired corporate culture (Sanjay & Peter, 2006). It is important to analyze and understand the context under which any tool will be used given that the wrong use can lead to failure (Womack et al., 1990).

2.4 Lean Beyond Manufacturing

Lean principles were originally developed for manufacturing operations as a set of tools and practices to be used by workers and managers to reduce waste in production systems resulting in reduced costs, improved quality, and reduced cycle times (Corbett, 2007). As western manufacturers noticed the superior performance achieved by Lean producers in Japan over the traditional mass

production system, western companies tried to emulate the structural part of Lean with shop-floor techniques as an attempt to remain competitive in the market.

The concept of Lean has been expanding to different industries as a valid approach for structuring and development of organizations (Hines, Holwe, & Rich, 2004; Höök & Stehn, 2008). Under the premise that the problems faced in manufacturing companies were universal, Womack et al. (1990) began promoting a thesis of transferability of Lean principles to non-manufacturing companies. Attempts to implement Lean in non-manufacturing industries span a wide variety of industries from healthcare (Radnor, Holweg, & Waring, 2012; Teich & Faddoul, 2013) to the public sector (Maleyeff & Campus, 2007; Waterman & McCue, 2012) with successful results in cost reduction and increased quality (Pedersen & Huniche, 2011). For example, Radnor et al. (2012) presented a case study of the implementation of Lean in the English national health service (NHS). The aim of the study was to look further at how Lean is applied in healthcare organizations and to determine the contextual factors that moderate implementation. Radnor et al. (2012) assessed four public healthcare organizations that have implemented Lean in one or several parts of their organization. The findings of the study showed that although Lean is being implemented in healthcare organizations, it is generally focused towards the "tool level" and not to a more system-wide approach. Organizations generally were involved the application of specific tools such as Kaizen, rapid improvement events, and 5S systems, which tend to produce small scale and localized productivity. Radnor et al. (2012) further analyzed some of the possible causes of why Lean is not being fully implemented and compares the healthcare industry to the manufacturing industry to explain the causes. Radnor et al. (2012) explained that although both manufacturing and healthcare are successful in identifying the "customer value", healthcare is predominantly designed to be capacity-led. For instance, there is limited ability to influence demand or make full use of freed-up resources. Radnor et al. (2012) closes stating that the problems faced in the

healthcare industry are more managerial and organizational in origin and they need to be addressed to improve the productivity at the systems level.

Transition from traditional to Lean environment is more about culture change in the organization than about process issues. Although any organization seeking to implement Lean initiatives share the same goal of improving performance by reducing the waste of operations, the approach or strategy of implementation needs to be tailored to the realities of specific environments (Corbett, 2007).

2.5 Lean in Enterprise Transformation

Enterprises can be defined as complex highly integrated systems comprised of organizations and processes with multifaceted interdependencies and interrelationships across boundaries (Nightingale & Rhodes, 2004). Organizations are obligated to continuously change the way they operate to achieve their strategic business objectives (Nightingale, 2009). However, many of these organizations undergoing Lean transformation struggle to find the balance between showing short term success and achieving a long term impact at the enterprise level (Nightingale, 2009). Failing to consider the whole "enterprise system" may lead to short term improvements that are not sustainable over time and may sub-optimize the enterprise as a whole (Nightingale, 2009).

Lean can be divided at two levels: operational and strategic. The operational level focuses on improving lower level operations by the implementation of Lean tools or practices. These tools or practices may be specific to some industries and may not transfer to other sectors satisfactorily. On the other hand, the strategic level focuses on customer-centered principles that apply at all levels of the organization causing a bigger impact in the long term (Hines et al., 2004). Many companies trying to implement Lean achieve only a local impact in their organization since they focus only on the operational level. These companies implement Lean tools at the shop-floor level but fail to implement

the strategic level with the organizational culture and mindset needed to achieve an impact on the overall system's performance (Hines et al., 2004).

A good conceptual model to help understand the composition of a Lean system and how the operational and strategic levels relate to each other was developed by Hines, Found, Griffiths, and Harrison (2008) called "The Iceberg Model" that describes the two levels of Lean: operational and strategic. This framework (Figure 1) is composed of two main parts: the visible part of the iceberg (above water) represents the operational level including process management, technology available, and tools and techniques. The part below water represents the strategic level conformed by enabling elements of alignment and strategy such as leadership, behavior, and engagement.

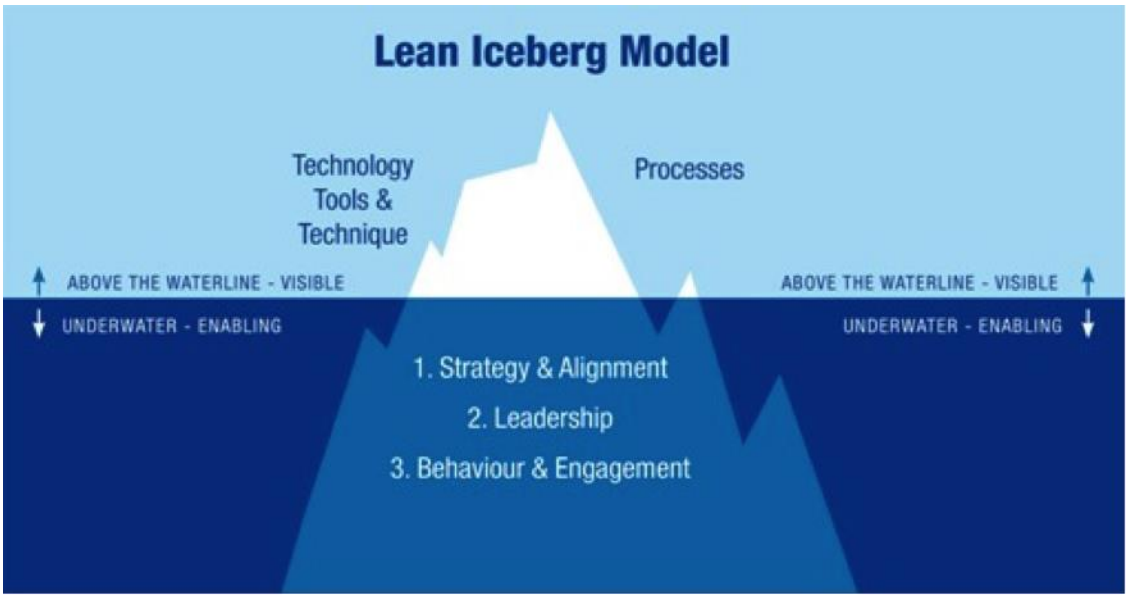

Figure 1. Lean Iceberg model
Source: (Hines et al., 2008)

This model provides a good visual representation of the importance of the human role in Lean. According to this model, a proper strategy should be the foundation of the whole process, supported by determined leadership and engaged workforce to understand and apply a set of tools and techniques to improve the way work is being done in the organization (Radnor, 2010). Several studies in both public and private organizations support the Lean iceberg model concluding that strong management support,

workers commitment and development of a proper strategy are critical factors for the successful implementation of Lean initiatives (Achanga, Shehab, Roy, & Nelder, 2006; Maleyeff & Campus, 2007; Pedersen & Huniche, 2011; Scherrer-Rathje, Boyle, & Deflorin, 2009).

The iceberg model provides an introduction of key elements for Lean implementation. However, there is no specific roadmap on the implementation of Lean of those elements in an organization. Some authors have developed more systematic models and divide the implementation process of Lean in different phases identified during Lean implementation (Drew et al., 2004; Harbour, 2001; Jorgensen et al., 2007). Jorgensen et al. (2007) provide a model based on literature review and experiences from 12 Danish companies currently implementing Lean. The model presented by Jorgensen et al. (2007) aim to support an organization in the process of Lean transformation by describing the stages of Lean capability necessary for sustained implementation and suggest a framework for assessing a company's current level of Lean capability maturity. He identified five different phases during a Lean implementation:

1. Sporadic optimization - This level is characterized by occasional rather random efforts at optimization in various organizational units, but these activities are not planned or implemented on the basis of an overall strategy or a specific philosophy. The optimization projects are typically led by experts with little to no general employee involvement. Organizational mechanisms and systems are not integrated with lean philosophy and/or lean objectives.

2. Basic lean understanding and implementation - Lean has now been chosen as the philosophy that will serve as the basis for operation control and optimization. The experts and general workforce have received basic training and pilot projects have been initiated in isolated units within the organization for the purpose of experimenting with the individual lean tools and methods. This is the phase where the program implements lean systems and tools, such as Kaizens and Kanban systems.

3. Strategic lean interventions - The implementation of lean is now a part of the organization's strategy and projects and activities are planned on the basis of established goals and objectives. Knowledge of and practical experience with lean tools and methods as well as a lean philosophy are widely acknowledged and recognized at all levels of the organization, although initiatives are still primarily implemented according to an established plan. Satisfactory performance improvements are achieved. Specific HR systems (i.e. selection, compensation, training functions) are aligned with lean objectives to support lean goals.

4. **Proactive lean culture -** Lean activities occur continuously from all areas of the program. To think and act lean has become a part of the daily work, and CI is more of a habit than a specific task, although efforts have not yet been made to extend these efforts outside of the organization's own boundaries. The practical understanding of lean tools and methods is quite high and these are used actively by all members of the organization to develop and implement performance improvements. All HR functions are aligned with lean objectives for the purpose of supporting long term sustainability. Focus on, e.g. career development via lean and extended developmental activities (e.g. external education).

5. Lean in the enterprise - The lean strategy is no longer just an internal strategy and its impact is visible in activities throughout the enterprise level. Lean activities are planned, implemented, and monitored across the enterprise boundaries. Knowledge sharing and knowledge transfer are important components of the act ivies across the enterprise and organizational structures support inter-organizational network building.

2.6 Enabling and Facilitating Factors in Lean Implementation

Organizations are complex and dynamic systems that interact with a number of internal and external factors that may make implementation of any process improvement initiative difficult. Some

authors focused on the implementation process of Lean initiatives in different industries have investigated the factors that may facilitate or hinder the process of implementation of Lean. However, most of the case studies available are based on the manufacturing industry which may have different characteristics compared to other industries (Achanga et al., 2006; Janssen & Estevez, 2013; Losonci, Demeter, & Jenei, 2011; Pedersen & Huniche, 2011; Sanjay & Peter, 2006; Scherrer-Rathje et al., 2009). Some of the most common factors include limited implementation experience, a tendency of workers to return to old routines (resistance), low management commitment, lack of training and education, poor communication and failure to link Lean with the organization's goals (Achanga et al., 2006; Radnor, 2010; Schiele & McCue, 2011). Factors influencing the success of Lean initiatives may vary depending on the type of industry and the organizational environment of the organization. Table 1 shows a collection of barriers and enablers during the implementation of Lean initiatives

Table 1. Barriers and success factors during the implementation of Lean initiatives

Issue	**Barrier**	**Enabler**
Resources	Insufficient resources (technical, financial, human)	Sufficient resources
Management	Lack of management awareness and support	Management commitment
Objective	Cost-cutting, layoffs	Improve processes and work
Link to strategy	Misaligned	Aligned
Employees	Employee resistance	Employee commitment and belief in the process
Need for change	No real or perceived crisis	Burning platform
Knowledge or experience	Limited experiences in change management	Long history of successfully managed projects
Staffing	Poor selection of change agents and improvement teams	Presence of improvement champion and dedicated staff
Time plan	Slow pace of change	Realistic timescales for changes

(Table 1 continued)

Issue	Barrier	Enabler
Culture	Need for culture change	Supportive organizational culture for change
Competence building	Inadequate training and education	Comprehensive training and education
Ownership to improvements	No ownership to improvement initiatives	Ownership to improvement
Impacts	Failure to document benefits from Lean	Significant, visible impacts from Lean
Dominant mindset	Individual thinking	Whole systems thinking
Knowledge transfer	Little to none transfer of knowledge	Knowledge transfer
Rewards	No rewards or recognition from participating in Lean	Recognition of success to members of the process
Communication	Poor communication	Effective communication between all levels of the organization

Most authors agree that top management support, good organizational culture, good strategy and communication and continuous training and development is necessary to achieve a successful implementation of Lean at the enterprise level in the long term (Achanga et al., 2006; Humbert, Mesia, & Griffin, 2012; Nightingale, 2009; Pedersen & Huniche, 2011; Scherrer-Rathje et al., 2009; Schiele & McCue, 2011). Pedersen and Huniche (2011) carried out a study to identify the determinants of Lean implementation in a public Danish institution. They conducted direct interviews with 29 managers and employees of the public institution that have been involved in the planning and implementation of Lean projects over the past 2 years by the time of the interview. The authors divided the results into four main success factor groups: the first factor consisted of goals and values within the organization. Pedersen and Huniche (2011) explain that all employees and managers in the organization may not

share the same goals and values regarding how work should be done in the organization affecting the support of any Lean initiative by creating resistance to change. The second success factor relates to the importance and complexity of the project. Most of the interviewees reported that they were more willing to participate in smaller and simpler projects that didn't involve interaction with other departments given the low success rate of complex interdepartmental projects. The third success factor involves a balance of power in the department where all managers and staff need to be involved in the development and coordination of the project to avoid future resistance that may lead to the failure of the project. Finally, resources available are important for the implementation of the project. Most workers identified time as a key issue given that these kinds of projects increase their workload since they need to take part of their regular work day to be part of them.

The knowledge of these factors is crucial given the complexity of the implementation of Lean which usually faces a large number of obstacles and usually does not happen properly in the first attempt (Achanga et al., 2006; Scherrer-Rathje et al., 2009; Schiele & McCue, 2011). Furthermore, many researchers agree that the process of transformation to Lean differs as a function of the characteristics of the organization. Prior to its implementation, it is crucial to analyze the organization environment to conveniently adapt the implementation process (Furterer & Elshennawy, 2005; Höök & Stehn, 2008; Sánchez, Gómez, Bolea, Arjona, & Ceballos, 2012). The following section discusses four factors identified in the literature as critical to have a sustained Lean organization in the long term.

2.6.1 Top Management Support

Before starting to implement Lean initiatives in an organization, it is critical to establish management support. Several studies have found a positive correlation between management commitment and the success of Lean (Achanga et al., 2006; Soriano-Meier & Forrester, 2002). In organizational change, managers need to play the roles of coaches and champions of change and not

the role of a person who is constantly monitoring the organization for signs of resistance (Armenakis, 1993). Furthermore, management should have a clear understanding of the initiatives, good education, and willingness to support improvement initiatives since they are the ones that provide inspiration, energy and support necessary to create readiness for change (Achanga et al., 2006; Armenakis, 1993). Senior managers need to introduce a clear vision of the concept of Lean, provide the resources necessary, and create a culture that fully supports improvement (Achanga et al., 2006; Schiele & McCue, 2011). In addition, senior managers need to consistently display the desired ways of Lean for others to observe and imitate (Boyne, 2002).

2.6.2 Organizational Culture

The concept of organizational culture could be referred to as "the way things are done around the organization" in a practical and philosophical point of view (Höök & Stehn, 2008; Schein, 2004). The culture in an organization is highly influenced by practices used by its employees. Höök and Stehn (2008) explain that Lean culture can relate to this definition since the concept has been developing throughout the years and is now a valid concept for structuring and developing organizations. Lean should be viewed more as a philosophy to run the organization than as a process to fix things given that when more people believe in this philosophy the implementation process of improvement initiatives becomes easier and improvements of higher magnitude can be accomplished (Sanjay & Peter, 2006).

Lean is a dynamic process that involves changes and may challenge the organizational structures and management process of any organization. These changes may influence the core values and beliefs held by the organization, policies or guidelines for decision making, current processes, and even the way that people work together within the organization, opening possibilities to some level of resistance (Schiele & McCue, 2011). Liker (2004) explains that one of the factors that led the Toyota system to its success is their organizational culture of discipline. He expands by discussing how an organization can

implement these management principles which are the basis of the reputation that Toyota has gained regarding its quality and efficiency. The establishment of a supportive and innovative organizational culture is critical for the implementation of Lean (Achanga et al., 2006).

2.6.3 Strategy and Communication of Goals

Planning and explaining the purpose behind Lean transformation is critical in the process and it may decrease fear and resistance of other members in the organization. The definition of clear and measurable goals is associated with both quantitative performance such as efficiency, and production targets as well as quality performance like innovation and employee morale (Verbeeten, 2008). Verbeeten expands saying that performance measurement systems should be developed with the people that work with those processes in order to create ownership. Creating ownership in the measurement system increases the morale, belief, and commitment of employees facilitating its implementation. For instance, it is important that key leaders and staff share the same values and belief towards the measurement system in order to achieve a long-term improvement effect.

In creating readiness for change, a message for change needs to be communicated among members of an organization. This message should address two issues. The first is an awareness of the need for change, which is the discrepancy between the current state and the desired end state of the organization. Creating the belief that change is necessary requires showing relevant contextual factors such as changes in governmental regulations that explain how the current performance of the organization differs from that desired or needed end state (Armenakis, 1993). The second issue refers to individual and collective efficacy of members involved in the process of change. Although awareness for change is a powerful motivator, this may also bring some negative thoughts from workers feeling overwhelmed or thinking that their work and hard effort is not appreciated. For instance, it is important that this counter reaction is corrected by building confidence among members of the organization by

highlighting their capacity to overcome any negative behavior that doesn't add to the success of the change initiatives (Armenakis, 1993; Bandura, 1982).

2.6.4 Continuous Training and Development

Training the employees involved in the process about the philosophy and tools of Lean is important to establish a basis of knowledge so the employees can start applying that knowledge on the process they are responsible for managing and become more aware of the type of benefits that are possible with its use (Schiele & McCue, 2011). Allowing employees to be part of the process of identifying and opportunities for value creating, and participating in rapid improvement events increases employee commitment causing that other people involved to see Lean as a sustainable way of managing work on a day to day basis (Bhatia & Drew, 2006; Sanjay & Peter, 2006; Schiele & McCue, 2011).

2.7 Lean in the Public Sector

The public sector has been developing new strategies to change the way it delivers services to the public. The need by government to deliver more for less combined with an increasing demand of the public asking for better performance and quality of services have forced the public sector to adopt industrial practices. Different strategies and methodologies such as TQM, Six Sigma, and Lean have been applied to improve the way the public sector delivers services with some showing more success than others (Dixit, 2002; Lan & Rainey, 1992; Verbeeten, 2008). In particular, Lean is considered a good management approach for the public sector as it shares the same core value of customer focus related to the public sector. Radnor and Boaden (2008) define Lean within the public sector a philosophy that aims to develop good practices that allow a reduction of waste and improvement of flow through the development of a culture of continuous improvement that involve everyone. Lean has been growing in popularity in the public sector in recent years showing positive results in terms of culture and cost

effectiveness (Radnor, 2010). Lean can help public sector organizations to streamline processes by addressing the causes of organizational inefficiency, building management systems and capabilities to sustain new ways of working by engaging managers and staff to engage in a culture of continuous improvement (Gebre, Hallman, Minukas, & O'Brien, 2012). Although some authors have criticized the transferability of Lean to the public sector, Lean is a philosophy that continues to evolve to fit particular characteristics of each industry (Hines et al., 2004). Most authors agree that although Lean can be transferred successfully to the public sector, it requires significant modifications (Radnor, 2010; Scorsone, 2005). For example, it is important to consider during Lean transformation that some tasks that may not add any value to the process are required by law and cannot be changed.

The use and adaptation of Lean techniques in the public sector can be viewed as an innovative managerial response to government demands for more efficient services and large reductions in public spending (Carter et al., 2011). Radnor and Boaden (2008) divided Lean and techniques used in the public sector in three categories: assessment, improvement, and monitoring. Assessment looks at the processes at the organizational level to understand the current state of the processes and map the desired end state. Improvement includes the tools to support and improve processes such as 5S, structured problem solving, and Kaizen. Monitoring relates to the measurement and monitoring of the impact of the processes and their improvement in terms of quality, time, costs, and satisfaction levels. A major difference that contrasts Lean from other approaches is that Lean is both a managerial philosophy that aims to change the organization's culture and values and also a set of tools and practices that attempt to improve processes (Waterman & McCue, 2012). Lean may improve the way the public sector is designed and manage by improving the way goods and services are provided while balancing the needs of different stakeholders involved in the process. By combining a set of tools and techniques such as root-cause problem solving approaches, implementation of goals and process measures used to monitor and control results, and flexible standardization of processes, Lean can set the base of process

improvement initiatives within the organization (Schiele & McCue, 2011). However, not all academics are as optimistic with the use of Lean in the public sector. Carter et al. (2011) discusses that the reorganization of processes and workflow under Lean involves the implementation of a Tayloristic management approach that degenerates the job enrichment and empowerment of front line workers in the public sector. Carter et al. (2011) expands saying that the introduction of performance surveillance systems and standardization of processes associated with Lean not only degrades the work life of employees but also forces previously autonomous skilled workers with substantive knowledge of sophisticated processes or techniques to perform what he considers as semi-skilled "assembly line work".

On the other hand, Radnor (2010) points out that most public sector organizations where Lean initiatives have been implemented indicate significant impact related to cost, quality, time, and satisfaction from both staff and customers. A positive aspect of Lean is that other approaches or tools such as TQM and Six Sigma can be integrated without contradicting the core objective of Lean (Hines et al., 2004). For example, Furterer and Elshennawy (2005) combined two improvement methods consisting of Lean and Six Sigma. The authors implemented Lean Six Sigma tools and principles to the financial administration processes in a local government entity to streamline the processes and reduce the completion time of the financial process. The processes of the department include payroll, accounts receivable, purchasing and accounts payable, and monthly reconciliation. The major problems faced before the Lean Six Sigma implementation were that the processes were inefficient, error-prone, and lengthy with an extensive number of non-value added steps. In addition, the department didn't have any qualitative or quantitative system to measure the performance. The results of implementing a Lean Six Sigma program included a significant reduction of processing time with payroll time reduced by 60%, purchasing and accounts payable processing time reduced by 40%, accounts receivable processing time

reduced by 90%, and monthly reconciliation processing time reduced by 87%. In addition, the number of financial system problems reported decreased by half, going from 13 per month to about 6 per month.

Another example of Lean implementation in a local government organization is presented by Radnor (2010) who carried out a study in a public institution in the UK that employees more than 10,000 people and provides logistics services to a wide number of sectors including automotive, technology, aerospace, defense, leisure and rail. The goal of the study was to examine which Lean manufacturing tools and techniques can be transferred and implemented into the public department as well as their impact as viewed by the staff within the department. Radnor (2010) conducted a case study approach visiting ten sites within the department interviewing 296 employees throughout the organization. The ten sites included five large processing offices, two distributed processing offices, and three national processing centers. The purpose of the interviews was to gain understanding of the level of implementation and knowledge of Lean tools of the departments. The results showed an improvement in productivity, quality and better understanding of the process and its levels of waste (non-value activities) by the implementation of Lean. However, these improvements were achieved mostly by focusing on the operations (standard work, 5S, takt time, workload balancing, visual management, key performance indicators, process hubs) and implementation (diagnostic, seven wastes, value stream mapping,) tools rather than continuous improvement ones (problem solving, go and see, workplace audit, location assessment, Lean environment), meaning that there was a bigger focus on waste reduction rather than understanding value which could lead to a highly efficient process that provides the wrong service or product. Radnor (2010) concluded that one of the causes of this result was the lack of technical knowledge of the tools and level of maturity within the organization. Another major finding by Radnor (2010) was the direct correlation between the engagement of senior leaders and the attitude of staff towards Lean. Radnor (2010) noted that to implement Lean within the public sector, people in the organization need to have a maturity level that changes the culture of the organization to be aware

of the need to improve processes and be willing to accept and sustain any changes that may be performed. This study supports other studies (Pedersen & Huniche, 2011; Waterman & McCue, 2012) that highlight the importance of implementing not only the operational level of Lean but also the strategic level with the cultural change to avoid resistance and facilitate the transition.

Most examples of Lean implementation in the public sector show that the major problems faced during Lean implementation are centered at the strategic level of Lean. This coincides with the literature of critical success factors of Lean implementation in other industries presented in section 2.6. However, it is fair to say that Lean in the public sector is still under-researched in comparison to other areas like manufacturing and healthcare where more precise and specific information is available (Radnor, 2010). Most of the literature reflects assessments of the success of Lean that are usually restricted to measuring the impact of Lean at the operational and financial level leaving aside the impact at the human or strategic level of Lean implementation (Losonci et al., 2011).

The impact of implementing Lean is not as easy to measure at the strategic level as it is at the operational level. The strategic level has a more comprehensive and wider content where Lean is not viewed just as a tool but as a way of thinking to pursue excellence in the production or services provided emphasizing customer value and the entire system flow (Wang & Huzzard, 2011). Many authors support that the use of assessment tools can provide information of the impact of Lean at the strategic level (Doolen, 2005; Jorgensen et al., 2007; Nightingale & Mize, 2002; Perkins, Abdimomunova, Valerdi, Shields, & Nightingale, 2010). Assessment tools can be used as a roadmap to Lean implementation as they provide information of the current state of organization and the impact of the improvement initiatives at both the process and strategic level (Jorgensen et al., 2007). The following section discusses the benefits of the use of assessment tools in Lean implementation and introduces some of the tools that have been developed by other authors.

2.8 The Role of Assessment in Lean Transformation

Assessment tools are critical to successful Lean implementation as they facilitate the necessary organizational learning and development to sustain Lean in the long term (Abdimomunova & Valerdi, 2010; Jorgensen et al., 2007). Assessment allows an organization to determine trends and analyze the impact of changes in organizational conditions in performance (Abdimomunova & Valerdi, 2010; Van de Ven & Ferry, 1980). It also stimulates managers to implement improvement initiatives in opportunity areas. Last, assessment shows the impact of previous improvement initiatives (Van de Ven & Ferry, 1980)

A good Lean assessment tool needs to include both a technical perspective and an organizational perspective. The technical perspective is related to the operational level of Lean and includes performance, methods, and tools in relationship to the company's strategic scope (Jorgensen et al., 2007). The organizational perspective is related to the strategic level of Lean and reflects management, organizational and human capabilities, culture, and learning (Hines et al., 2004). The Lean assessment tool should measure these two perspectives in a balanced way to evaluate the possible synergy created by focusing attention on both perspectives simultaneously. Parker (2003) carried field research at a UK-based company that manufactures and assembles large vehicles to study whether Lean implementation was related to negative effects on employee outcomes. The author assessed four groups with varying involvement with Lean twice over a 3-year period. The results from the study indicated that employees in all Lean production groups were negatively affected with those involved in the assembly lines showing the worst results with reduced organizational commitment and role breadth efficacy. In addition, mediational analyses showed that the negative effects of Lean were in part attributable to declines in perceived job characteristics such as autonomy, skill utilization, and participation in decision making. Although these results may seem discouraging, they cannot be generalized as there are a wide number of factors that could have affected the results of the studies

such as the methodology, assessment tool, or even the organizational culture of the company where the study was conducted. Unfortunately, research that studies the impact of Lean at the strategic level is very scarce and there is no consensus of best methods and tools used to do this kind of research. However, academic and industrial researchers have developed tools to assess the impact of Lean. Some of these assessments have been used in previous research as a tool to link Lean implementation with organizational performance (Abdimomunova & Valerdi, 2010; Doolen, 2005). Some tools include:

- **Survey of Perceptions of a Company's Leanness** – It is 36 question survey tool used to assess a company's leanness. The survey is available in different versions to be used by various stakeholders like executives, employees, investors, suppliers, and customers. The topics addressed by the survey include waste identification and reduction, value stream management, continuous improvement, flow, employee development, and leadership.
- **The Lean Company Survey -** Benchmarking survey used to request information on performance changes attributable to lean, infrastructure details, functional involvement in lean, and implementation details
- **Strategos Lean Assessment -** This assessment helps to investigate, evaluate, and measure nine key areas of manufacturing. The result is a deeper understanding of key issues, problem areas, and potential solutions. The Lean Manufacturing Assessment has a questionnaire that explores nine key areas. There are 3-6 questions for each area with multiple-choice answers. A scoring worksheet totals the score for each section and provides an overall Lean Index.
- **Lean Checklist Self-Assessment -** Assessment tool that allows the organization to establish a baseline measurement of Lean progress. The topics include a range of management and lean practices.

- **Lean Enterprise Self-Assessment Tool (LESAT) -** The LESAT is an enterprise level assessment tool designed to guide leadership through the transformation process towards a more lean enterprise. The LESAT was developed by a team of professionals from industry, government and academia representatives working together under the Lean Advancement Initiative (LAI) and is intended to be a self-assessment that integrates the perspectives and standpoints of critical members in the enterprise leadership to guide through the transformation process of a more lean organization . The tool has 54 questions divided in three sections: lean transformation leadership, life cycle processes, and enabling infrastructure.
- **Government Lean Enterprise Self-Assessment Tool (GLESAT) -** The GLESAT is a modified version for government of the Lean Enterprise Self-Assessment Tool (LESAT) developed by a team of professionals from industry, government and academia representatives working together under the Lean Advancement Initiative (LAI). This tool is intended to be a self-assessment of the perceived present state and the readiness for change of the organization helping to determine the extent to which Lean principles, practices, and behavior have become parts of the organization. The version used in the present study (GLESAT) contains 55 practices divided in three sections, each broken down into different parts as shown in figure 2. The first section (enterprise leadership) is comprised of 28 practices and refers to the processes and leadership attributes that support the transformation to Lean principles and practices. The second group (lifecycle and enabling processes) has 19 questions and refers to the processes responsible for the product or services from creation to its delivery. Lastly, the third group (enabling infrastructure) has 8 questions and refers to the processes that provide and manage the resources that enable the enterprise operations (Abdimomunova & Valerdi, 2010).

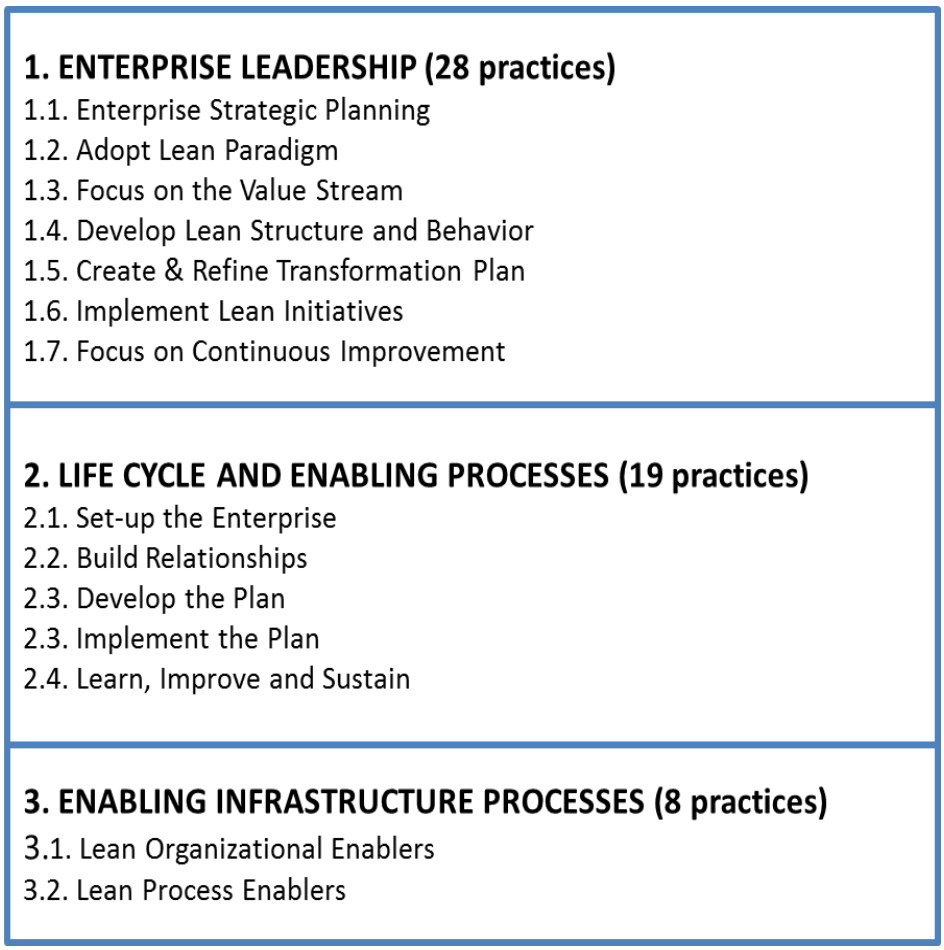

Figure 2. GLESAT structure
Source: (Nightingale & Mize, 2002)

A major problem found during the review of Lean assessment tools was that most of the tools are specific to the manufacturing industry and would require modifications if implemented in the public sector. Also, the majority of the assessment tools focus exclusively on the operational level and not the strategic level (Jorgensen et al., 2007). Table 2 provides a table with the criteria used to select the assessment tool for the represent research.

Table 2. Criteria table
Source: modified from (Doolen, 2005)

Tool	Author	Industry	Availability
Survey of Perceptions of a Company's Leannes	Jordan and Michel (2001)	Manufacturing	No
The Lean Company Survey	Lean Learning Center (2003)	Manufacturing	No
Strategos Lean Assessment	Strategos consultants	Manufacturing	No
Lean Checklist Self-Assessment	Rober Abair Associates, Inc. (2002)	Manufacturing	Yes
Lean Enterprise Self-Assessment Tool (LESAT)	Nightingale and mize (2002)	Manufacturing	Yes
Government Lean Enterprise Self-Assessment Tool (GLESAT)	Nightingale (2008)	Public Sector	Yes

The Lean assessment tool selected for the present research was the GLESAT. An important criterion to select the Lean assessment tool was its transferability to the public sector. Table 2.8.1 shows that only the GLESAT is designed specifically to the public sector while the other tools have emphasis on the manufacturing industry. The second criterion was the availability of the tool. Most of the Lean

assessment tools have been developed by consultant companies and would involve some cost to use the tool for research purposes. However, The GLESAT was developed for research and industrial purposes and it is available to be used for the present research without any cost. Third, the GLESAT has an emphasis on assessing the strategic level of Lean which is the focus of the present research. This tool assesses areas such as management support, effective communication, continuous learning and development, and organizational enablers of the organization. These factors were identified in the literature as key success factor for successful Lean implementation in the public sector, making this tool a valuable resource to be used in the present research. However, a downside of this tool is the lack of literature reporting its implementation. Although there is literature on the implementation of the LESAT (Abdimomunova & Valerdi, 2010; Nightingale & Rhodes, 2004) which is very similar to the GLESAT in terms of structure and content, there is no report of the implementation of the GLESAT to the knowledge of the authors.

3 RESEARCH METHODOLOGY

The aims of this study were to develop a better understanding of the association of Lean implementation in the levels of agreement and cohesion between managers and staff in evaluating perceived current state and desired state of organizational practices. The study took place within two different programs of the Office of Public Health (OPH) of the Department of Health and Hospitals (DHH) for Louisiana. The surveys used for the study were the Government Lean Enterprise Self-Assessment tool (GLESAT) and an Employee's demographic survey. The GLESAT is a self-assessment of the perceived present state and the readiness for change of the organization helping to determine the extent to which Lean principles, practices, and behavior have become parts of the organization.

3.1 Data Collection Chart

The study was conducted in 2 different programs within OPH. Figure 3 shows that each participating program was assessed in parallel and was classified as Lean or Non-Lean. Each participant assessed the current state and the desired state of each of the 55 assessed practices of their program. The data collected was analyzed separately by the job role of the respondent in the organization (manager or staff).

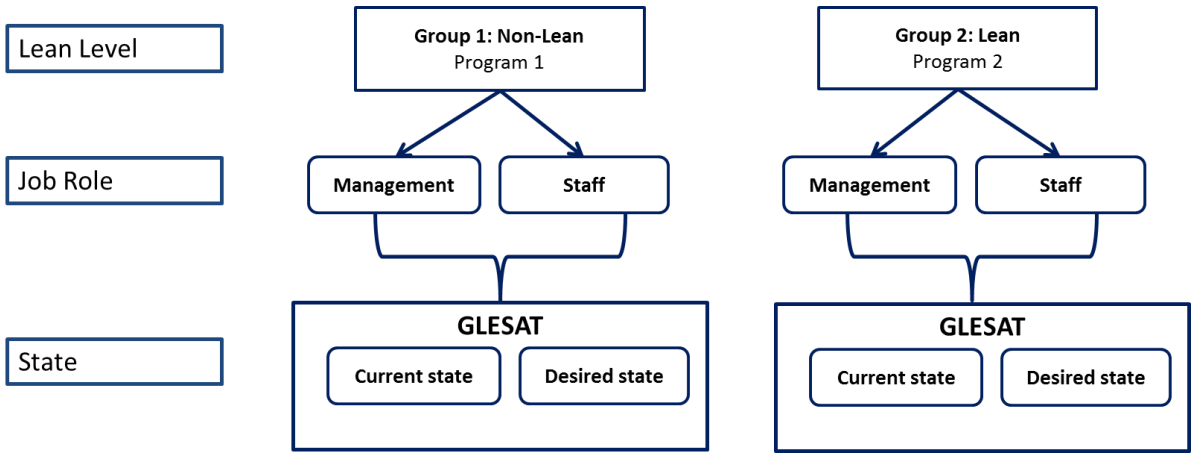

Figure 3. Data collection plan

3.2 Assessment Tools

Two surveys were used to assess this study: Employee demographics, and the Government Lean Enterprise Self-Assessment Tool.

3.2.1 Employee Demographics Survey

The demographic survey was a 10 question survey (Appendix C) that provided information about the name of the program, years of work experience at the participating program, role in the program, years of work experience in the private sector, years of work experience in the public sector, familiarity with Lean tools and principles, percent of work time spent on process improvement projects, number of Lean projects involved, barriers of Lean implementation and Lean practices used in the program.

The survey listed 4 barriers that have been identified in previous research of Lean implementation in the public sector as critical for the successful implementation and sustainability of Lean in the long term (Pedersen & Huniche, 2011; Radnor & Boaden, 2008). These critical barriers include:

1. Lack of management support – Management support is critical in implementing any change in the organization. Lack of management support can lead to reluctance to implement a transformation plan.
2. Poor organizational culture - refers to a culture where staff accepts initiatives for change and develops a sense of ownership. A poor organizational culture creates high resistance towards change
3. Lack Strategy and poor communication – A clear message of the goal and strategy needs to be communicated across all sites. It is important to disseminate success stories and facilitate the transfer of knowledge within and between departments.

4. Lack of Training – A good understanding of tools and process is important for employee commitment and deployment of the transformation plan.

The survey included these critical barriers as a way to facilitate the identification of such barriers. In addition, another cell was included for the participant to add other barriers that he/she felt as a barrier of Lean implementation.

3.2.2 Government Lean Self-Assessment Tool (GLESAT)

The main tool used was the Government Lean Enterprise Self-Assessment Tool (GLESAT, Appendix D). Respondents assessed 55 practices through two sets of ratings, one for the perceived current state performance and one for the future or desired state performance of the program (Perkins et al., 2010). Each practice was assessed on a capability maturity scale of 1 to 5 where level 1 is the lowest or minimal awareness of the practice and 5 is a world-class or recognized best practice (Figure 4).

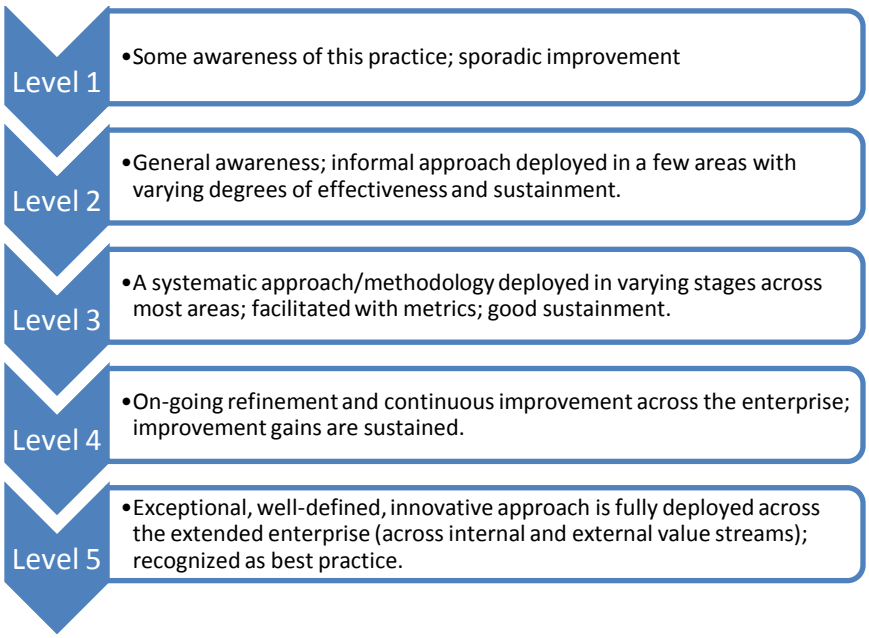

Figure 4. Generic Capability Maturity Level
Source: (Nightingale & Mize, 2002)

The results of this survey were analyzed by individually looking at the scores of each practice, averaging across sections, or looking at the overall score. Review and analysis on an individual level can help identify weaknesses and strengths of specific areas and can help visualize areas for improvement. Looking across whole sections can be used as a leading indicator for evaluating organizational performance and identify possible areas for improvement.

3.3 Experimental Design

3.3.1 Participants

Participants of this study were program functional managers and staff that perform daily functions of the program. Although the proposed sample size was of 60 participants, 7 participants were not able to perform the study due to availability during the established time frame. Table 3 shows the distribution of the participants by group (Lean and non-Lean) and by job role (Manager and staff). The non-Lean group had 25 participants in total for a participation rate of 83%. The Lean group had 28 participants in total for a participation rate of 93.3%.

Table 3. Participant distribution

Group	Manager	Staff	Total
Non-Lean	13	12	25
Lean	15	13	28
Total	28	25	53

Out of 53 participants, 46 samples (22 participants from the Non-Lean group and 24 participants from the Lean group) were considered valid. The main cause of discarding 7 samples was due to the participants filling more than one possible answer in some of the assessed practices.

3.3.2 Dependent Variables

The dependent variable was the level of perceived current organizational maturity and desired Lean state of the respondents across each of the programs which were further categorized into the three main sections of the questionnaire: enterprise leadership, life cycle and enabling processes, and enabling infrastructure.

3.3.3 Independent Variables

The independent variables include the job function (Manager or staff), the Lean level of each program at the time of the assessment (Lean and Non-Lean) and the state of the practice being assessed (current vs desired).

3.3.4 Setting

The study was performed in two different programs within the Office of Public Health (OPH). The main goal of OPH is to improve population health and reduce disparities in health outcomes by promoting policies and environmental change that prevent transmission of infectious diseases and the reduction of environmental hazards (Louisiana Department of Health and hospitals, 2013). This office is composed of six centers that provide oversight to more than 50 programs and initiatives. These programs are created to serve a specific population in Louisiana and have specific goals and objectives that support the main goals of OPH.

The programs selected for this study were picked based on their availability and willingness to participate in the research. Each program was categorized as either Lean or Non-Lean depending on their experience with Lean:

3.3.5 Procedure

The Institutional Review Board of LSU approved the research. Office executives of OPH were contacted via email to request authorization to perform the study and support on identifying possible

programs that could participate. Once the possible programs were identified, an email requesting availability and willingness to participate in the study was sent to the program director (see Appendix B). Once the program director agreed to participate, a meeting was scheduled to introduce the objective of the studies, discuss the activities of the program, identify program staff and managers that would participate in the study and schedule the dates to perform the study. Then, possible identified participants were contacted via email to request their participation in the study and obtain information about their availability and possible dates to perform the study. The process of assessing each program was performed independently from each other and the order of the programs assessed was based on availability of the program directors and staff of the program.

On the day of the assessment, verbal and written explanation of the experiment was given to the participants. Participants had the opportunity to ask questions at any time during and after the assessment. Then, participants were asked to read and sign the consent form (Appendix A) before starting the study. During the first part of the study, participants completed the demographics survey. In the second part, the participants had to first read the instructions of the assessment and then answer the 55 questions of the GLESAT which are divided into three main sections. Once the participant read the question and the levels of maturity, he or she had to identify the "current" level or state of the program (C) and the "desired" state that he or she believes that is tangible and optimum for the program in a 1 year timeframe. Furthermore, there was an "evidence or opportunities" section where the participant had the chance to provide written comments regarding that practice that may facilitate the improvement process identifying enablers or barriers faced. Participants were allowed to ask any questions before, during, and after the assessment to the researcher. The assessment process was designed to last 45 to 60 minutes. The participant's name and program were deleted from all information of the consolidated raw data breaking any link between the response and the name of the person with the original response.

3.4 Data Analysis

The data was entered into a spreadsheet for further analysis in a numerical format. Tests of normality (Kolmogorov-Smirnov) and homogeneity of variance (Levene's test of equality of variances) were performed at a significance level of 0.05 prior to conducting any inferential statistics. The null hypothesis for normality test stated that the data is normally distributed and alternative hypothesis stated that the data was not normally distributed. Results from the normality test revealed insufficient information to reject the null hypothesis (minimum p-vale = 0.200). The null hypothesis for Levene's test stated that the group variances are equal and alternative hypothesis stated that that the group variances are not equal. Results from the Levene's test revealed insufficient information to reject the null hypothesis (minimum p-value = 0.179). There is insufficient evidence to claim that the variances between the groups are not equal. The data met the preconditions to use ANOVA.

To perform further analysis, the data received by the respondents was clustered by Lean level (Lean and Non-Lean), state (current and desired) and by job role (managers and staff). Assessing the current performance or Lean state provides insights regarding current Lean adoption in the organization and current maturity in the organization where low scores represent practices that have not been adopted yet and may require more attention while current high scores indicate perceived organizational success in that practice. The desired scores provide feedback on the participant's perceived importance of different practices to the organization. This means that the desired scores can be seen as a reflection of the priorities and values of the organization (Perkins et al., 2010). A high desired score represents practices that are of extreme importance to the participant while a low score may indicate a low priority practice or a misunderstanding of the potential that the practice may bring to the program. Comparing the average current state indicates the perceived current Lean state and maturity of managers and staff while comparing the average desired state illustrates if there is a difference in priorities and values between managers and staff.

The scores of the each section were determined by clustering the data by job role and then calculating the mean scores for the overall results of the GLESAT and then by each section separately. The analysis was divided in three main sections: 1. Lean level significance, 2. Job role significance, 3. Gap analysis of current and desired Lean states and 4.Comparative analysis between Non-Lean and Lean. In order to test the hypotheses framed in the next sections, a three-Way analysis of variance (ANOVA) was conducted on GLESAT scores at a significance level of 0.05. The three independent variables tested included: Lean level (Non-Lean and Lean), state (current and desired), and job role (manager and staff). SPSS 22 was used to perform all statistical analysis.

3.4.1 Lean Level Significance

The following hypotheses were framed to determine if overall scores of the Non-Lean group and the Lean group differed significantly:

Hypothesis test 1: **H_{01}:** There is no difference in current state overall scores of the Non-Lean group and Lean group

H_{11}: There is a difference in current state overall scores of the Non-Lean group and Lean group

Hypothesis test 2: **H_{02}:** There is no difference in desired state overall scores of the Non-Lean group and Lean group

H_{12}: There is a difference in desired state overall scores of the Non-Lean group and Lean group

3.4.2 Job Role Significance

The following hypotheses were framed to determine if perceived current organizational maturity and desired Lean state of the program between managers and staff differ significantly:

Hypothesis test 3: **H_{03}:** There is no difference in perceived current level of program maturity between two job roles.

H_{13}: There is a difference in perceived current level of program maturity between two job roles.

Hypothesis test 4: **H_{04}:** There is no difference in perceived desired Lean state level of program between two job roles.

H_{14}: There is a difference in perceived desired Lean state level of program between two job roles.

3.4.3 Gap Analysis of the Current and Desired State

A gap analysis consists of calculating the difference between manager and staff responses on the three main sections of the GLESAT. This analysis was performed for each participating program independently and then grouped by their Lean level. The gap score was used to assess the association of Lean with gap reduction.

For current Lean state, a large gap would indicate that managers and staff have a significantly different perspective on how they perceive the Lean state of the program while a small gap would indicate the opposite. In addition, a positive value in the current state could suggest that managers are more optimistic on the way they perceive their program is performing than the staff. A negative value would indicate that the staff has a more optimistic perception than the managers of how their program is performing.

For the desired Lean state, a large gap in the scores suggests that managers and staff may share different values, have different priorities, or have a different vision on how the program should or could run. A small gap would indicate that values and priorities of managers and staff are streamlined and are

aiming at developing an organization under the same Lean principles. The following proposition is framed:

P_1: As program has higher Lean scores in its practices, the gap in perceived current and desired Lean state between managers and staff is reduced.

3.4.4 Comparative Analysis of Lean Levels

The following hypothesis was framed to check whether the gap between ratings of staff and managers decreases:

Hypothesis test 5: **H_{05}:** the gap size for the scores between managers and staff do not differ significantly from each other in the non-Lean and Lean groups

H_{15}: : the gap size for the scores between managers and staff do differ significantly from each other in the non-Lean and Lean groups

4 RESULTS

The present research was carried out in two programs within the Office of Public Health with one of them currently undergoing Lean implementation. The data was collected over the course of 17 meetings organized in association with the program managers. Participants completed the assessment in approximately 50 minutes.

4.1. Descriptive Statistics

The data obtained from the GLESAT was classified by Lean level (Lean or Non-Lean), by state (current or desired), and by job role (manager or staff). Then, the data was analyzed looking to the overall score of the current and desired state of each program and then looking at each of the three sections that compose the GLESAT: (1) Enterprise leadership, (2) life cycle and enabling processes, and (3) Enabling infrastructure.

Table 4 shows the results of the Lean and non-Lean group obtained from the demographic section of the study. The table shows the number and percentages of the responses of each question. The percentage was calculated dividing the number of responses of each question by the total number of participants of the Lean level group.

Table 4. Participant demographic information

		Lean	Non-Lean
		Number of participants	**Number of Participants**
Years working in the program	0-2	0 (0%)	7 (32%)
	2-5	0 (0%)	1 (5%)
	5-10	7 (29%)	4 (18%)
	10+	17 (71%)	10 (45%)
Years of experience in public sector	0-2	2 (8%)	1 (5%)
	2-5	1 (4%)	2 (9%)
	5-10	4 (17%)	5 (23%)
	10+	17 (71%)	14 (64%)

(Table 4 continued)

		Lean	Non-Lean
		Number of participants	**Number of Participants**
Perceived familiarity with Lean tools	No Knowledge	0 (0%)	5 (23%)
	Poor	4 (17%)	10 (45%)
	Moderate	15 (63%)	7 (32%)
	Very Good	7 (29%)	0 (0%)
	Excellent	1 (4%)	0 (0%)
Percent of time spent working on Lean six sigma	0-20	3 (13%)	21 (95%)
	21-40	12 (50%)	1 (5%)
	41-60	6 (25%)	0 (0%)
	61-80	3 (13%)	0 (0%)
	81-100	0 (0%)	0 (0%)

Participants of the Lean group had longer time working on their program than participants from the Non-Lean group. All 24 participants from the Lean group had more than 5 years working in the program compared to 14 out of 22 from the Non-Lean group. In addition, the Lean group was more familiar with Lean with 23 out of 24 participants having at least moderate knowledge compared to only 7 out of 22 in the Non-Lean group.

The different level of Leanness between the two programs was validated performing an independent samples t-test (Table 5) on the results of the two groups in questions 6 and 7 of the demographics questionnaire (appendix 7.4). Question 6 of the demographics questionnaire refers to the perceived familiarity with Lean of the participant while question 7 asked the participant to give an estimate of the percent of their working time using Lean Six Sigma. Average results of question 6 showed that the perceived familiarity with Lean of the Non-Lean group was significantly lower than the Lean group. Average results for question 7 showed that the Non-Lean group spent significantly less time on average (2.59%) than the Lean group Lean six (52.1%) incorporating Lean six sigma in their work processes.

Table 5. T-test for participant familiarity with Lean and time spent in Lean six sigma

	Group	N	Mean	P-Value	T-Value
Perceived familiarity with Lean	Non-Lean	22	2.136	0.0000	-5.52
	Lean	23	3.304		
Percent of working time spent in Lean Six Sigma	Non-Lean	22	2.59%	0.0000	-11.94
	Lean	23	52.1%		

4.2. GLESAT Overall Scores

Scores for this section were determined by calculating the mean for each participant of all 55 practices that compose the three sections of the GLESAT. The mean and standard deviation of the overall score broken down by Lean level, state and job role and the ANOVA results are presented in table 6 and table 7.

Table 6. Overall GLESAT scores for current and desired state

Overall - Current State				**Overall - Desired State**			
Level	**Job role**	**N**	**Mean (SD)**	**Level**	**Job role**	**N**	**Mean (SD)**
Non-Lean	Manager	11	1.60 (0.49)	**Non-Lean**	Manager	11	3.25 (0.73)
	Staff	11	1.8 (0.61)		Staff	11	3.55 (0.65)
Lean	Manager	10	2.48 (0.40)	**Lean**	Manager	10	3.81 (0.38)
	Staff	14	2.31 (0.61)		Staff	14	3.90 (0.45)

Table 7. ANOVA results for GLESAT overall scores

Source	F	P-Value	Observed Power
Lean Level	24.061	.000*	.998
State	187.943	.000*	1.000
Job role	1.089	.300	.178
Lean level * State	.869	.354	.151
Lean level * Job role	1.967	.164	.284
State * Job role	.446	.506	.101
Lean level * State * Job role	.249	.619	.078

Table 7 shows the ANOVA results for the GLESAT overall scores. The overall scores of the Lean group were higher than the Non-Lean group by 41.18% for the current state and 13.53% for the desired state. ANOVA Results showed that Lean level, F (1, 84) =24.061, p<0.001, power=.998 and State F (1, 84) =187.943, p<0.001, power=1.00 were the main significant effects. However, there was no significant difference in the responses between managers and staff in the overall scores (job role F (1, 84) =1.089, p=0.300, power=0.178).

The gap between managers and staff calculated by subtracting the scores of the staff group to the overall scores of the manager group (manager scores – staff scores) for the current and desired state. Average results showed a reduction in the gap scores between managers and staff of the Lean group compared to the Non-Lean group in both current and desired state. For the current state, the gap score of the Lean group was 15% smaller than the Non-Lean group. For the desired state, the gap score of the Lean group was 70% smaller than the Non-Lean group (Figure 5 and 6). However, ANOVA results showed that the interaction between Lean level and state, F(1,84)=0.869, p=0.354, power=0.151, Lean level and job role F (1,84)=1.967, p=0.164, power=0.284, state and job role F (1,84)=0.446, p=0.506, power=0.101 and Lean level, state, and job, F (1, 84) =0.249, p=0.619, power=0.078, were not significant. This means that that although there was a difference in the overall average scores between managers and staff of the Lean and Non-Lean group, this difference was not statistically significant

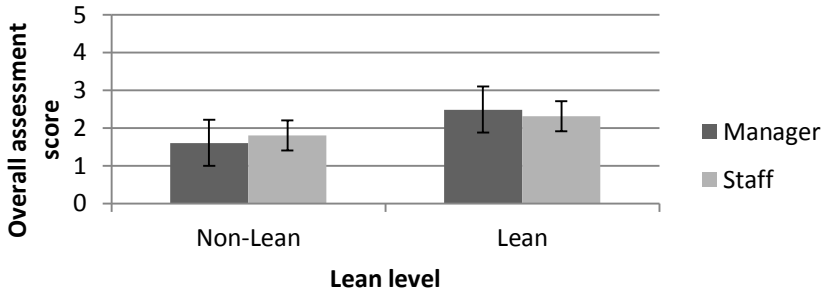

Figure 5. Gap between managers and staff for current state

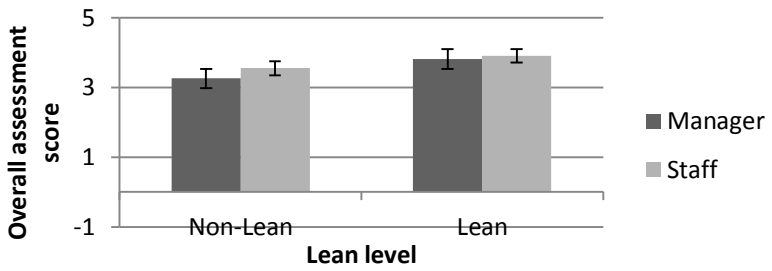

Figure 6. Gap between managers and staff for desired state

4.3. Section 1: Enterprise Leadership

Scores for this section were determined by calculating the mean for each participant of all 28 practices that compose the enterprise leadership section of the GLESAT. The mean and standard deviation of the overall score broken down by Lean level, state and job role and the ANOVA results are presented in table 8 and table 9.

Table 8: Section 1 scores for current and desired state

Section 1 - Current State				Section 1 - Desired State			
Lean Level	**Job role**	**Sample**	**Mean (SD)**	**Lean Level**	**Job role**	**Sample**	**Mean (SD)**
Non-Lean	Manager	11	1.50 (0.52)	**Non-Lean**	Manager	11	3.23 (0.74)
	Staff	11	1.74 (0.62)		Staff	11	3.53 (0.71)
Lean	Manager	10	2.62 (0.40)	**Lean**	Manager	10	3.94 (0.42)
	Staff	14	2.40 (0.62)		Staff	14	4.06 (0.42)

Table 9. ANOVA results for Lean transformation and leadership section of the GLESAT

Source	**F**	**Sig.**	Observed Power
Lean level	41.813	.000*	1.000
State	191.589	.000*	1.000
Job role	.950	.333	.161
Lean level * State	1.362	.246	.211
Lean level * Job role	1.914	.170	.277
State * Job role	.729	.396	.135
Lean level * State * Job role	.389	.534	.095

Table 9 shows the ANOVA results for the Lean transformation leadership section of the GLESAT (Section 1). Section 1 scores of the Lean group were higher than the Non-Lean group by 53.7% for the current state and 18.64% for the desired state. ANOVA results showed that Lean level, $F(1, 84) = 41.813$, $p<0.001$, power=1.00 and state $F(1, 84) = 191.589$, $p<0.001$, power=1.00, were the main significant effects. However, there was no significant difference in the responses between managers and staff in section 1 of the GLESAT (job role, $F(1, 84) = 0.950$, $p=0.333$, power=0.161).

Average results showed a reduction in the gap scores between managers and staff of the Lean group compared to the Non-Lean group in both current and desired state. For the current state, the gap score of the Lean group was 8.33% smaller than the Non-Lean group. For the desired state, the gap score of the Lean group was 60% smaller than the Non-Lean group. However, ANOVA results showed that the interaction between Lean level and status, $F(1,84)=1.362$, $p=0.246$, power=0.211, Lean level and job $F(1,84)=1.914$, $p=0.170$, power=0.77, status and job $F(1,84)=0.227$, $p=0.396$, power=0.135 and Lean level, state, and job, $F(1, 84) = 0.389$, $p=0.534$, power=0.095, were not a main significant effect. This means that that although there was a difference in section 1 scores between managers and staff of the Lean and Non-Lean group, this difference was not statistically significant.

4.4. Section 2: Life Cycle and Enabling Processes

Scores for this section were determined by calculating the mean for each participant of all 19 practices that compose the life cycle and enabling process section of the GLESAT. The mean and standard deviation of the overall score broken down by Lean level, state and job role and the ANOVA results are presented in table 10 and table 11.

Table 10. Section 2 scores for current and desired state

Section 2 - Current State				Section 2 - Desired State			
Level	**Job role**	**Sample**	**Mean (SD)**	**State**	**Job role**	**Sample**	**Mean (SD)**
Non-Lean	Manager	11	1.74 (0.50)	**Non-Lean**	Manager	11	3.31 (0.73)
	Staff	11	1.92 (0.61)		Staff	11	3.54 (0.63)
Lean	Manager	10	2.25 (0.45)	**Lean**	Manager	10	3.58 (0.54)
	Staff	14	2.24 (0.60)		Staff	14	3.72 (0.54)

Table 11. ANOVA results for Lean lifecycle process section of the GLESAT

Source	**F**	**Sig.**	Observed Power
Lean Level	6.564	.012*	.717
State	148.345	.000*	1.000
Job role	1.150	.287	.185
Lean Level * State	.553	.459	.114
Lean Level * Job role	.325	.570	.087
State * Job role	.154	.696	.067
Lean Level * State * Job role	.042	.838	.055

Table 11 shows the results for the Lean lifecycle process section of the GLESAT (Section 2).Section 2 scores of the Lean group were higher than the Non-Lean group by 21.86% for the current state and 6.71% for the desired state. ANOVA Results showed that Lean level, $F(1, 84) = 6.564$, $p=0.012$, power=0.717, and state $F(1, 84) = 148.345$, $p<0.001$, power=1.00 were the main significant effects. However, there was no significant difference in the responses between managers and staff in section 2 of the GLESAT (job role, $F(1, 84) = 1.150$, $p=0.287$, power=0.185).

Average results showed a reduction in the gap scores between managers and staff of the Lean group compared to the Non-Lean group in both current and desired state. For the current state, the gap score of the Lean group was 94.44% smaller than the Non-Lean group. For the desired state, the gap score of the Lean group was 39.13% smaller than the Non-Lean group. However, results showed that the interaction between Lean level and status, $F(1,84)=0.553$, $p=0.459$, power=0.114, Lean level and job $F(1,84)=0.325$, $p=0.570$, power=0.087, status and job $F(1,84)=0.154$, $p=0.696$, power=0.067 and Lean level, state, and job, $F(1, 84) = 0.14$, $p=0.838$, power=0.055, were not a main significant effect. This

means that that although there was a difference in section 2 scores between managers and staff of the Lean and Non-Lean group, this difference was not statistically significant

4.5. Section 3: Enabling Infrastructure

The mean and standard deviation of the overall score broken down by Lean level, state and job role and the ANOVA results are presented in table 12 and table 13. Scores for this section were determined by calculating the mean for each participant of all 8 practices that compose the enabling infrastructure section of the GLESAT.

Table 12. Section 3 for current and desired state

Section 3 - Current State				**Section 3 - Desired State**			
Level	**Job role**	**Sample**	**Mean (SD)**	**State**	**Job role**	**Sample**	**Mean (SD)**
Non-Lean	Manager	11	1.63 (0.48)	**Non-Lean**	Manager	11	3.22 (0.76)
	Staff	11	2.15 (0.81)		Staff	11	3.69 (0.70)
Lean	Manager	10	2.44 (0.40)	**Lean**	Manager	10	3.81 (0.50)
	Staff	14	1.99 (0.48)		Staff	14	3.64 (0.50)

Table 13. ANOVA results for the enabling infrastructure section of the GLESAT

Source	**F**	**Sig.**	**Observed Power**
Lean Level	5.211	.005(*)	.616
State	138.342	.000(*)	1.000
Job role	.514	.476	.109
Lean Level * State	.050	.824	.056
Lean Level * Job role	9.478	.003(*)	.860
Job role * State	.191	.663	.072
Lean Level * Job role * State	.427	.515	.099

Table 13 shows the results for the enabling infrastructure section of the GLESAT (Section 3). Section 3 scores of the Lean group were significantly higher than the Non-Lean group by 15.34% for the current state and 7.51% for the desired state. ANOVA results showed that Lean level, $F(1, 84) = 5.211$, $p = 0.025$, power=0.616, and State $F(1, 84) = 138.342$, $p < 0.001$, power=1.00 were the main significant effects. However, results showed that job role, $F(1, 84) = 0.514$, $p = 0.476$, power=0.109, was not a main significant effect.

Average results showed a reduction in the gap scores between managers and staff of the Lean group compared to the Non-Lean group in both current and desired state. For the current state, the gap score of the Lean group was 13.46% smaller than the Non-Lean group. For the desired state, the gap score of the Lean group was 63.83% smaller than the Non-Lean group. Results showed that the interaction between Lean level and status, $F(1,84)=9.478$, $p=0.003$, power=0.860 was a significant main effect. However, Lean level and job $F(1,84)=0.05$, $p=0.824$, power=0.056, status and job $F(1,84)=0.191$, $p=0.663$, power=0.072, and Lean level, state, and job, $F(1, 84)=0.427$, $p=0.515$, power=0.099, were not a main significant effect.

4.6. Hypothesis Testing

This section includes the hypotheses testing of the null hypotheses and alternative hypotheses stated in the research methodology section based on the p-values from the ANOVA.

4.6.1 Hypothesis 1

ANOVA results showed that current state scores were influenced by Lean level, $p<0.001$, therefore the null hypothesis is rejected. There is a significant difference in the current state scores between the Non-Lean and Lean group for the overall results and the three sections of the GLESAT.

4.6.2 Hypothesis 2

ANOVA results showed that desired state scores were influenced by Lean level, $p<0.001$, therefore the null hypothesis is rejected. There is a significant difference in the desired state scores between the Non-Lean and Lean group for the overall results and the three sections of the GLESAT.

4.6.3 Hypothesis 3

ANOVA results showed that there was not enough evidence to reject the null hypothesis, $p>0.05$. Thus, there is no significant difference in current state scores between managers and staff in the overall results or any of the sections of the GLESAT.

4.6.4 Hypothesis 4

ANOVA results showed that there was not enough evidence to reject the null hypothesis, $p>0.05$. Thus, there is no significant difference in desired scores between managers and staff in the overall results or any of the sections of the GLESAT.

4.6.5 Hypothesis 5

The two way interaction between Lean level and job role provided by the ANOVA showed that there was not enough evidence to reject the null hypothesis, $p>0.05$. Thus, the gap scores between managers and staff do not differ significantly from each other in the non-Lean and Lean groups.

5 DISCUSSION AND CONCLUSION

The purpose of this research was to study the association of Lean implementation with organizational maturity in the public sector. More specifically, the research evaluated the association of Lean implementation in the levels of agreement and cohesion between managers and staff in evaluating perceived current state and desired state of organizational practices. Current state refers to the current performance of the practice assessed. The desired state is designed to represent a realistic and achievable level of performance of the practice assessed in a timeframe of 1 year (Perkins et al., 2010).

Many authors agree that implementing Lean can improve team interaction and cohesion by enhancing factors such as team communication, awareness, understanding, innovation and learning (Schiele & McCue, 2011; Tsasis & Bruce-Barrett, 2008). Team cohesion has important influences on the ability of teams to perform effectively over time and has a positive effect on team satisfaction and team viability (Tekleab, Quigley, & Tesluk, 2009). The results of the present study provide empirical data to discuss the association of lean implementation with improvements on team communication and awareness and understanding of organizational practices. In the study, participants of the Lean group expressed during the assessment that Lean has impacted upon tools, practices and behaviors leading to improved quality and productivity. These outcomes were reflected in the assessment scores where the Lean group had higher scores than the Non-Lean group on practices that involved process quality, good organizational communication and improvement of current processes (I.C.3, I.D.3, I.D.7, I.E.2, and I.E.3). Also, participants mentioned that performance became more visible and accountable by using statistical information to look at productivity to challenge performance and design new transformation plans with realistic performance targets. These affirmations were looked at in the assessment scores where the Lean group had higher scores than the Non-Lean group (I.A, I.E, I.G, II.A, II.C, and II.D). Performance accountability represents a great improvement from traditional ways of operation in the public sector

which in contrast to the private sector, they lack competition and accountability in the services provided creating high operational cost and poor quality in the services provided(Boyne, 2002).

5.1. GLESAT Results

The first two hypotheses were framed to determine if GLESAT scores for the current and desired state of the Non-Lean group and the Lean group differ significantly. A three-way ANOVA was performed at a significance level of $\alpha=0.05$ for the overall scores obtained for the entire GLESAT. The p-values obtained helped determining if there were any significant differences between the three variables (Lean level, state, and job role) and the interaction between them. Results showed a significant difference in the overall average scores of the assessment for both the current and desired state between the Non-Lean and Lean program. The overall average score of the Lean group was 41.1% higher than the Non-Lean group for the current state and by 13.52% for the desired state. The scores for the current state of the Lean group mean that they have an overall higher maturity than the Non-Lean group on the assessed practices. This result seems logical as a team that has worked with Lean for a longer period of time is likely to have more Lean experience leading to higher maturity in their practices. Results for the desired state indicate that the Lean group has higher expectations to improve their practices when compared to the Non-Lean group.

The Lean Transformation and Leadership section of the GLESAT (Section 1) assesses the leadership of an enterprise and their ability to effect a transformation to a Lean enterprise. This means that this section focuses on practices created and maintained by upper-level management to guide enterprise leaderships (Nightingale & Mize, 2002). Results showed a significant difference in the overall average scores of the assessment for both the current and desired state between the Non-Lean and Lean program. The overall average score of the Lean group was higher by 53.70% than the Non-Lean group for the current state and by 18.63% for the desired state. The sub-sections with the highest

contrast were I.B (Adopt Lean paradigm) and I.E (create and refine implementation plan) with the Lean group having higher scores by 133% and 53% than the Non-Lean group. This sub sections assess practices that involve management support, training in Lean, commit resources for Lean and employee empowerment. These results for the current state could mean that management from the Lean group does a better job establishing the necessary support and incentives to create a Lean environment than its counterpart of the Non-Lean group. Results of this section coincide with Barton and Delbridge (2006), who found that management from companies using a Lean approach take various steps to enhance a continuous improvement and innovation philosophy where lower level employees are encouraged to participate in team based problem solving of current practices and the design of new practices for the company. For the desired state, the results indicate that the Lean group has higher priority and expectations for improving their practices than the Non-Lean group (Perkins et al., 2010). Higher expectations in this section could be linked to a high level of commitment from the employees to implement better strategies and practices that support a Lean environment. Having a high level of employee commitment is a critical enabler for implementing change strategies as it reduces the resistance among employees and supports a long term sustainability for the new practices (Pedersen & Huniche, 2011; Schiele & McCue, 2011). Results for this section also showed a lower standard deviation in the average scores of the Lean group for both the current and the desired state. This low variability supports the statement of the previous paragraph about having a better cohesion, understanding, and agreement in the Lean group in comparison to the Non-Lean group.

The Lean Lifecycle Process section of the GLESAT (Section 2) assesses enterprise level practices that provide value to the customer and stakeholders (Nightingale & Mize, 2002). The practices in this section align with the core principles of Lean and its “Customer-centered” philosophy. Results showed a significant difference in the overall average scores of the assessment for both the current and desired state between the Non-Lean and Lean program. The overall average score of the Lean group was higher

by 21.85% than the Non-Lean group for the current state and by 6.7% for the desired state. The biggest difference in section 2 scores between the two groups was found on practices that involved incorporating customer value in the design of product of services (II.C.1, II.C.3, II.D.2, II.D.3, II.E.1) with more than 40% increase for the Lean group compared to the Non-Lean group. These results for the current state indicate that the Lean group has a higher enterprise maturity on the processes or services that provide value to the customers. This result agrees with researchers that support Lean as a management philosophy that focuses on identifying customer value and managing the value stream to provide better products or services(Sanjay & Peter, 2006; Teich & Faddoul, 2013; Womack et al., 1990). Womack et al. (1990) discusses how the Toyota production system has influenced the methods of production of the modern world by improving business relationship with customers and developing a process focused on what the customer really wanted. Results for the desired state indicate that the Lean group has higher priorities or expectations on performance compared to the Non-Lean group. This result may indicate a higher level of understanding of the importance of improving practices that provide value to the customer and the commitment to accomplish it.

The Enabling Infrastructure section of the GLESAT (Section 3) contains those Lean practices pertinent to the enterprise infrastructure necessary to support the implementation of Lean principles, practices and behavior at both the organizational and process level (Nightingale & Mize, 2002). Results showed a significant difference in the overall average scores of the assessment for both the current and desired state between the Non-Lean and Lean program. The overall average score of the Lean group was higher by 15.34% than the Non-Lean group for the current state and by 7.51% for the desired state. Practice III.A.1 (Financial system supports Lean transformation) and III.A.3 (Promulgate the learning organization) had the highest percent difference between the two groups with 42.86% and 25% higher in the Lean group compared to the Non-Lean group. These results indicate that the Lean group has better infrastructure in terms of organizational and process enablers that support the leadership and

processes of the organization. This result could indicate that the Lean group has implemented a better strategy for implementing Lean at both the organizational (strategic) and process level. Results for the desired state showed that the Lean group has higher expectations and priorities in improving the practices that support this section compared to the Non-Lean group. In a similar way to results for the current state in this section, higher results for the desired state could be due to higher support and commitment of upper management to deploy a better strategy and resources to implement a Lean culture compared to the Non-Lean group.

The third and fourth hypotheses were framed to determine if perceived current organizational maturity and desired Lean state between managers and staff differed significantly. Results showed that there was no significant difference in the current state or desired state results between managers and staff in the overall scores or any of the sections of the GLESAT. Despite the non-significance of the results, staff had higher scores than managers in the Non-Lean group for the overall scores and the three sections of the GLESAT when assessing both the current state and desired state of their program. In the Lean group, the difference varied between the current and the desired state. For the current state, managers had higher scores than staff in the overall scores and each of the three sections. This could be interpreted as managers being more optimistic than staff of current practices being implemented in the program (Perkins et al., 2010). For the desired state, managers had lower scores than staff in the overall scores and each of the sections. Like the conclusion drawn for the Non-Lean group, this result could mean that the staff group is more optimistic about their capabilities to improve their current practices in the future.

The fifth hypothesis of the study was framed to check the association of Lean implementation with a reduction of the gap scores of the assessment between managers and staff. Results showed that even though the Lean group had a smaller gap in the scores between managers and staff compared to

the Non-Lean group, the reduction was not significant. This means that no conclusive remark could be made based on the results. Results also showed a lower standard deviation for the overall results in the Lean group for both the current state and the desired state compared to the Non-Lean. This could mean that Lean implementation resulted in higher cohesion, understanding and agreement between participants of the Lean group. Perkins et al. (2010) attributes low levels of variance to strong cohesion, communication and cooperation across organizational boundaries while high levels of variance are attributed to lack of training, education, knowledge and understanding of the practices. Those factors can introduce a better overall understanding of the processes that lead the organization creating more awareness of current practices and expectations for improvement.

5.2. Barriers of Implementation

Different authors found in the literature have identified different barriers for the implementation of Lean. Some of the most common barriers include lack of management support, employee resistance, and organizational culture (Achanga et al., 2006; Pedersen & Huniche, 2011; Schiele & McCue, 2011). The present study asked participants in the demographics section to identify barriers of implementation of Lean initiatives. The survey identified four barriers and had an empty cell to identify any other barrier not listed that the participants perceived as a barrier. The four barriers listed included: Lack of management support, lack of training, lack of communication, lack of strategy, and poor organizational culture towards improvement. In addition to the barriers listed, participants identified employee resistance and understaffing as barriers of Lean implementation. Results shown in table 14 list the barriers identified by managers and staff from the Lean group. The Non-Lean group didn't identify any barriers due to their lack of knowledge about the topic.

Table 14. Barriers of Lean implementation

Barrier	Manager (n=10)	Staff (n=14)
Lack of management support	2	9
Lack of training	4	6
Lack of communication	3	4
Lack of strategy	3	4
Poor organizational culture towards improvement	7	1

Results obtained in the present study show a different perspective from other studies found in the literature. Although different research has identified barriers of Lean implementation (Achanga et al., 2006; Pedersen & Huniche, 2011; Schiele & McCue, 2011), none of the literature found classified the responses by the job role of the participants to identify any relation between responses and job roles. Lack of training, communication and strategy were identified by both managers and staff with a similar number of responses. This result supports the research performed by Sanjay and Peter (2006), which found lack of direction, lack of planning, and a lack of adequate project sequencing as the major difficulties encountered by companies attempting to apply Lean. However, responses for management support and organizational culture had contrasting results between managers and staff. A low number of managers (2) identified management support as a barrier compared to 9 identified by staff. Poor organizational culture was identified by 7 managers as a barrier while only 1 of the staff considered it a barrier. Although there is no specific guide for Lean implementation, these barriers can be minimized designing a good implementation strategy providing good communication across the value chain, training, and incorporating both staff and the customer on the design phase of transformation (Sanjay & Peter, 2006)

5.3. Limitations

The following were potential limitations associated with the study:

1. **Lean knowledge:** Some of the participants identified the assessment tool as being "non-friendly". Although a glossary of terms and proper guidance was provided to the participants during the study, some participants found some of the practices to be confusing and hard to understand. This behavior was mostly found in the Non-Lean group. The reason could be related to the lack of understanding and knowledge of terminology associated to Lean. This lack of knowledge was identified by the participants in the demographics section. For the Non-Lean group, 5 participants rated themselves as having no knowledge of Lean, 10 participants rated themselves as having poor knowledge, 6 as moderate knowledge, and 1 participant as having good knowledge of Lean. For the Lean group, 1 participant rated himself as having poor knowledge, 15 participants rated themselves as having moderate knowledge, 8 participants rated themselves as having very good knowledge, and 1 participant rated himself as having excellent knowledge of Lean. These results link the lack of understanding of the assessment tool with poor knowledge of Lean. As a consequence, the final results may have been affected for some practices.
2. **Different internal variables between programs:** The study was performed in two different programs. Although the two programs are under the same office, each perform different activities, has a different size, program management, resources and a different organizational structure. All these variables may affect the results of the study as different organizational culture may affect the way a person perceives the current performance and motivation for improvement.
3. **Motivation:** Lack of motivation is a factor that may have affected the results of the assessment. Although upper management encouraged the participants to perform the assessment, some of

the participants may have not been motivated or willing to take the assessment seriously to properly identify the current practices. Abdimomunova and Valerdi (2010) found that organizational culture and behaviors during the assessment process may impact the assessment results. For future research it would be appropriate to schedule an introduction session for the participants where management along with the facilitator introduces the benefits of the assessment to enhance the motivation and positive behavior towards the assessment.

5.4. Future Research

Based on the limitations, this study suggests few ideas for future research. Following are propositions that can be set as a base for future studies:

1. Future research can be based on a longitudinal study that assesses the current and desired state of the program before and after implementation. The same variables and research questions used in the present research could be studied: maturity level, desired state and gap reduction. A longitudinal study would eliminate or decrease the effect of variables such as program management, functions, and structure that could have affected the results of the present study.
2. Other assessment tools could be reviewed and tested on participants to provide feedback on their understanding and ease of use of the tools. Testing other assessments could provide feedback for the development of more friendly assessments that would be easier for the participants to respond providing higher accuracy in the responses.
3. The present research could be introduced to other industries to study if the results may vary depending on the industry where Lean is implemented. Although Lean is becoming very popular among the public sector, there are still many gaps on strategies for its implementation. For instance, it would be interesting to find out if Lean implementation has different results in

industries where there are more formal strategies for its implementation at both the strategic and process level.

5.5. Recommendations

A three-dimensional analysis was performed for the scores of each practice of the GLESAT for the Non-Lean and the Lean group across three dimensions: current state performance, variance and gap between current and desired state scores. This analysis uses the criteria developed by the Lean Advancement Initiative (LAI) during the use of the LESAT to assess functional units (Perkins et al., 2010). Table 15 shows the criteria and interpretation used to evaluate the scores of each practice of the GLESAT for the Non-Lean. The score range of each variable was set using the average value of the variable across all assessed practices in the Non-Lean group. For the current state, values below the score range are weak areas that need to be improved while a value above the score range indicate a strong practice that could be maintained or improved if needed. Variance scores above the score range indicate high disagreement between the members of the organization regarding their perception of the current state of the practice. Low variance scores indicate strong agreement in the perceived current state of the practice assessed. Gap results are the difference between the current and desired state of the practice. High gap scores indicate a big difference between where participants perceive they are and where they want to be. Those practices are a potential opportunity for improvement with strong support of the employees. Practices with low gap scores have perceived good performance or are low priority for the employee. Appendix 7.9 shows an analysis of each practice with a generic recommendation for further steps.

Table 15. Three-dimensional analysis criteria table for the Non-Lean group.
Source: modified from (Perkins et al., 2010)

Metric	Level	Score range	Interpretation	Recommendation
Current State	High	≥ 1.72	Strongest areas	Maintain or improve
	Low	< 1.72	Weakest areas	Improve
Variance	High	≥ 0.78	More disagreement. Need for training/education	Education needed
	Low	< 0.78	Strong agreement	No education needed
Gap	High	≥ 1.68	Opportunity to close the gap through Lean improvement	Take action
	Low	< 1.68	Opportunity to raise expectations or accept as is	No action

To highlight areas for potential improvement, results of the current state and gap of each practice were displayed on a scatter plot mapping the practices into the categories of a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis (Figure 7) and listed on a table for further discussion (appendix 7.10). The horizontal axis represents the current state of each practice while the vertical axis represents the gap score of each practice.

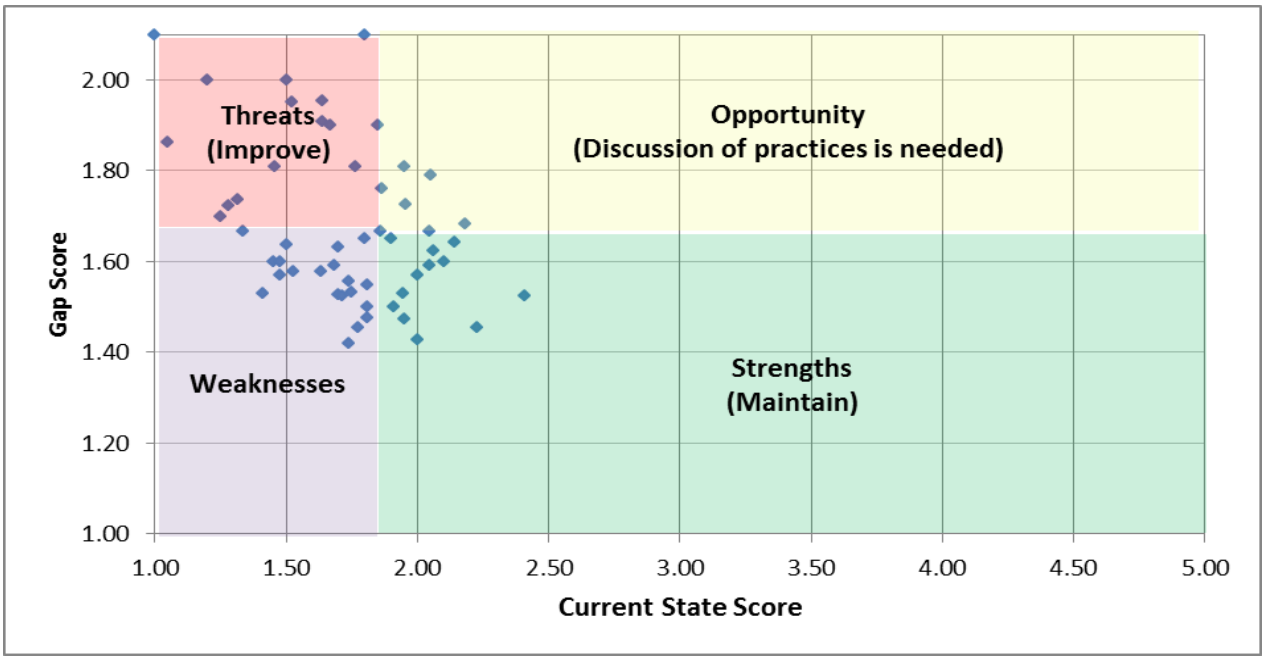

Figure 7. Mapping GLESAT scores of the Non-Lean group to SWOT analysis

For the Non-Lean group, the distribution of practices into the SWOT categories was as follows:

- Strength: 22 practices
- Weakness: 12 practices
- Opportunity: 7 practices
- Threat (High priority): 14 practices

Practices with high current state score and low gap score are considered as strengths of the organization. The high scores of the current state indicate that the organization has been doing a good job in this area while the low gap score indicate that the organization is satisfied with the performance of this practice. Practices with both low current state and low gap scores can be interpreted as weaknesses. The low current state scores indicate deficient practices that could be improved while the low gap score indicate that these practices are not considered as high priority. The low gap score could due to lack of understanding of the practice. Practices falling into this group should be addressed through education and training for the employees to gain understanding of the potential benefits of improving the practice and reduce resistance towards this change. Practices falling into the Opportunities category have a combination of high current performance and high gap scores. This indicates that although progress has been achieved in the improvement of this practice, the organization has high aspirations with regards to the assessed practice. For instance, it is likely that improvement of these practices will have a strong commitment from members of the organization. Practices with low current state level and high gap level are underperforming practices within the organization. These practices should be of high priority to the organization for improvement. The low current state score indicates that the organization was either unaware of the practice or have not paid good attention on the performance of it while the high gap score might suggest that there is a realization about the important role that this practice has in the organization as well as potential gains

from improving it. Table 16 shows the 14 practices that are considered as high priority and should be addressed in the short term.

Table 16. High priority practices for the Non-Lean group

Threat (High Priority) Practices
I.A.1. Integration of lean in strategic planning process
I.B.2. Senior management commitment
I.B.3 Lean Enterprise Vision
I.B.4. A sense of urgency
I.D.2. Relationships based on mutual trust
I.D.4. Employee empowerment
I.D.7. Lean change agents
I.E.2. Commit resources for lean improvements
I.E.3. Provide education and training
I.F.2. Tracking detailed implementation
I.G.3. Nurturing the process
I.G.5. Impacting enterprise strategic planning
II.D.2. Foster lean behavior throughout the value stream
III.A.3. Promulgate the learning organization

The majority of the practices listed are part of the Lean transformation and leadership section of the GLESAT. These practices are related to the strategic level of the organization involving areas related to the culture of the organization and transformational planning for change. Further discussion of these practices should take place to design a transformational plan for implementation of Lean initiatives. It is recommended that a Lean specialist is included in the design phase of a new transformation plan to help identify best approaches and tools to use during the implementation of phase of Lean. In addition, continuous training should take place in the organization to introduce the benefits of Lean and start developing a new organizational culture supportive of process improvement.

For the Lean group, an analysis of each practice independently with a generic recommendation for further steps was performed (appendix 7.10). Different values were used to set the score ranges

since this group had higher overall scores than the Non-Lean group. The score range of each variable was set using the average value of the variable across all assessed practices in the Lean group (Table 17).

Table 17. Three-dimensional analysis criteria table for the Lean group.
Source: modified from (Perkins et al., 2010)

Metric	Level	Score range	Interpretation	Recommendation
Current State	High	≥ 2.35	Strongest areas	Maintain or improve
	Low	< 2.35	Weakest areas	Improve
Variance	High	≥ 0.79	More disagreement. Need for training/education	Education needed
	Low	< 0.79	Strong agreement	No education needed
Gap	High	≥ 1.50	Opportunity to close the gap through Lean improvement	Take action
	Low	< 1.50	Opportunity to raise expectations or accept as is	No action

Results of the current state and gap of each practice were displayed on a scatter plot mapping the practices into the categories of a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis (Figure 8) and listed on a table for further discussion (appendix 7.10).

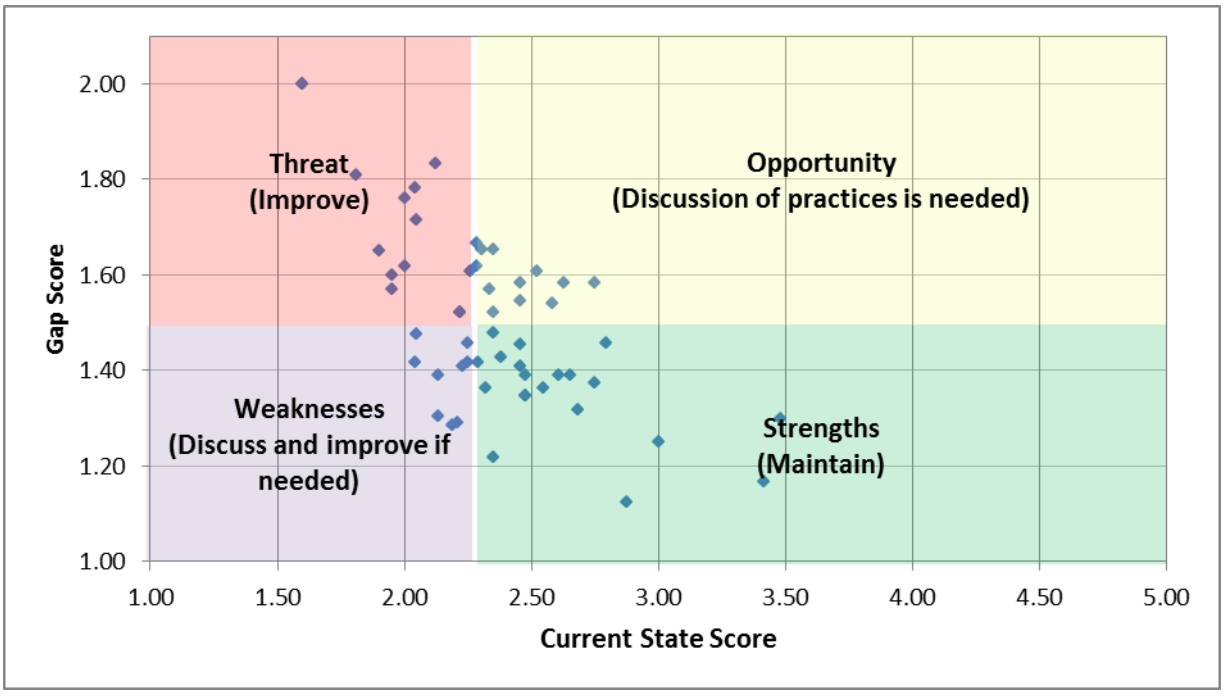

Figure 8. Mapping GLESAT scores of the Lean group to SWOT analysis

For the Non-Lean group, the distribution of practices into the SWOT categories was as follows:

- Strength: 16 practices
- Weakness: 13 practices
- Opportunity: 16 practices
- Threat (High priority): 10 practices

Table 18 shows the 10 practices that are considered as high priority and should be addressed in the short term.

Table 18. High priority practices for the Lean group

High Priority Areas
I.D.5. Incentive alignment
I.D.6. Innovation encouragement
I.D.7. Lean change agents
I.E.3. Provide education and training
I.G.4. Capturing lessons learned
II.C.5. Create a multidisciplinary approach
II.D.4. Transition product/service in a lean fashion
II.E.2. Provide post delivery service, support and sustainability
II.E.3. Maintain challenge of existing processes
III.A.2. Enterprise stakeholders pull required financial information

The Lean group showed a similar distribution for high priority practices between section 1 and 2 of the GLESAT as the non-Lean group. By focusing on transformation exercises on the listed practices, the organization can have substantial gain identifying opportunities for improvement with a strong level of support. Training plays a critical role in the implementation phase and sustainability of Lean. It is

recommended that the program continues introducing and training the tools and benefits of Lean to its members to continue improving the functions of the program.

5.6. Outcomes

1. The Lean group had an overall higher organizational maturity compared to the Non-Lean group. Results of the GLESAT showed that the Lean group had higher overall scores in all practices for both the current and the desired state.
2. Results showed that there was no difference in responses between managers and staff for either the Lean or Non-Lean group. This means that the responses of the participants in the assessment were not affected by the job role of participants.
3. Several barriers to Lean implementation were identified including lack of management support, lack of training, lack of communication, lack of strategy, poor organizational culture, employee resistance and understaffing as barriers of Lean implementation. These barriers match previous research that identified them as critical factors for the implementation and sustainability of Lean in the long term.
4. High priority practices were identified for both the Lean and the Non-Lean group. The Non-Lean group had 14 high priority practices while the Lean group had 10. These practices should be improved in the short term.

5.7. Conclusion

The present research sought to study the association of Lean implementation to the improvement of various factors that are part of the strategic level of an organization. Most authors agree that the implementation of Lean can bring a positive impact at the process level of an organization in terms of quality, processing time and cost of the services or products provided. However, there are different points of view of how Lean implementation affects the strategic level of an organization. Some

authors suggest that the Lean can increase employee understanding, interaction and behaviors in a positive way while some others suggest the opposite associating Lean to a Tayloristic approach that reduces employee morale and skill utilization. The current study examined the association of Lean with perceived organizational maturity by comparing the assessment scores between the two groups: Lean and Non-Lean. The Lean group had an overall higher organizational maturity compared to the Non-Lean group. These results are encouraging for public sector organizations that plan on implementing Lean to their programs as good organizational maturity is not only a good indicator that the organization is adopting best practices in the way services are delivered but it also plays an important role in the culture of the organization and their behavior towards change. Second, the present study sought to find the association of Lean implementation to an increase in understanding, communication, and cohesion between managers and staff. Results showed that there was no statistical difference in the gap scores of managers and staff of the Lean group compared to the Non-Lean group.

The barriers of Lean implementation found in this research include lack of management support, lack of training, lack of communication, lack of strategy, poor organizational culture, employee resistance and understaffing as barriers of Lean implementation. These findings coincide with other studies found in the literature (Achanga et al., 2006; Pedersen & Huniche, 2011). An interesting finding was the high contrast found in barriers that involved the role of the participant (e.g. low response rate for staff identifying employee resistance as a barrier or low response rate of managers identifying management support as a barrier).

Finally, an analysis of individual practices of the GLESAT was provided. Results of the analysis should be used as a starting point for managers to identify weaknesses and strengths of the organization as well as possibilities for improvement. Practices identified as priorities and opportunities should be addressed in the short term discussing openly with the members of the organization the current

situation to find possible solutions for improvement. Looking at individual practices of the GLESAT, the Lean group outscored the Non-Lean group by more than 100% difference in practices such as sense of urgency for change, understanding the current value stream, integration of a strategic planning process, and senior management commitment. These findings provide a good indication that Lean implementation can have a positive impact in the public sector not only at the process level but also at the strategic level by improving organizational maturity, awareness of current practices, and a sense of urgency to improve current practices. The improvement of those factors can reduce the resistance to change, motivate employees to improve performance and enable a better development and implementation of a transformation plan to improve the way the public sector operates. In addition, it is important that managers provide continuous training and communication among all levels of employees to assure that a culture of continuous improvement prevails in the long term.

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APPENDIX A: LSU IRB APPROVAL

ACTION ON EXEMPTION APPROVAL REQUEST

Institutional Review Board
Dr. Robert Mathews, Chair
130 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
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TO: Patrick O'Mara
MIE

FROM: Robert C. Mathews
Chair, Institutional Review Board

DATE: April 8, 2014
RE: **IRB#** E8763

TITLE: Impact of Lean implementation on perceived maturity levels of managers and staff in the public sector

New Protocol/Modification/Continuation: New Protocol

Review Date: 4/7/2014

Approved X **Disapproved**

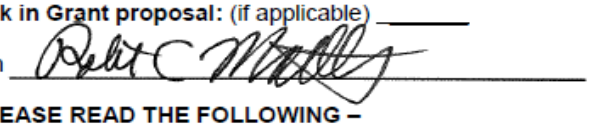
Approval Date: 4/7/2014 **Approval Expiration Date:** 4/6/2017

Exemption Category/Paragraph: 2

Signed Consent Waived?: No

Re-review frequency: (three years unless otherwise stated)

Protocol Matches Scope of Work in Grant proposal: (if applicable) _____

By: Robert C. Mathews, Chairman 

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING –
Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
7. Notification of the IRB of a serious compliance failure.
8. SPECIAL NOTE:

**All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb*

APPENDIX B: CONSENT FORM

Study Title: Association of Lean implementation on perceived organizational maturity levels of managers and staff in the public sector

Performance site:

Investigators:

Laura Ikuma, Ph.D. (likuma@lsu.edu) (225)578-5364, LSU, 2156 Patrick F. Taylor Hall

Patrick O'Mara (pomara1@lsu.edu) 225-249-2845

Purpose of the study: The present research project has the following purposes:

1. To identify the existence of a significant gap in the perceived current Lean maturity level and desired Lean state between managers and staff in the public sector.
2. To analyze whether the implementation of Lean tools and initiatives is associated on reducing the gap of perceived maturity level and desired Lean state.

Participants: Program functional management levels including program executive leadership, directors, office management and non-managerial employees that are critical in the process of implementing improvement initiatives.

Number of participants: 15-30 per participating program. 90-180 for the entire study

Study Procedure: After reading this consent form, a verbal explanation of the purpose and procedure of the experiment will be given. If you agree with the terms of participation, you will sign the consent form. You will be asked to fill two types of survey. Before starting the assessment, you will need to read the instructions on how to properly fill these surveys. The first survey (GLESAT) is intended to be a self-assessment of the perceived present state and the readiness for change of the organization helping to determine the extent to which Lean principles, practices, and behavior have become parts of the organization. Each question or practice is assessed on a capability maturity scale of 1 to 5 where level 1 is the lowest or minimal awareness of the practice and 5 is a world-class or recognized best practice. The second survey is an 8 question demographic survey that asks for information about the participant and is used for data grouping purposes. The assessment process is designed to last from 45 to 60 minutes.

Benefits and Compensation: There are no direct benefits or compensation for participation. However, by participating in this study you will be helping a graduate student to fulfill his graduation requirements and greatly contributing to understanding the impact of implementing Lean tools and principles at the strategic level of an organization.

Risks/Discomfort: There are no risks associated with this experiment.

Right to Refuse: Your participation in the study is completely voluntary and you may refuse to answer any question if you are not comfortable with it. You can stop participating in the study at any time and for any reason if you so decide.

Privacy: All information you supply during the research will be held in confidence and your name will not appear in any report or publication of the research. Your name and program name will be deleted from all information of the consolidated raw data breaking any link between the response and the name of the person with the original response.

Signatures: This study has been approved by the LSU institutional review board (IRB) and their contact information can be found on the following page. By signing below, you state that you have read and understood the idea and purpose of this survey and voluntarily give your consent to participating in it. This sheet with your signature will be separated from the actual survey to protect your identity.

Note the following page as it contains the contact information of the IRB and Principal Investigators.

Signature:_____ Date:_____

THANK YOU FOR YOUR PARTICIPATION!

APPENDIX C: RECRUITMENT EMAIL TEXT

Program Manager Recruitment Text

My name is Patrick O'Mara, graduate student from the Mechanical and Industrial Engineering Department at LSU. I am conducting research which involves employees of OPH programs that take part in improvement initiatives. I would be very grateful if you could participate in my study by agreeing to complete a 55 question survey designed to last 30 to 45 minutes. To minimize any inconvenience to your workday, I can schedule this survey any time and visit you personally to give the survey. To participate, please email me at pomara1@tigers.lsu.edu with your phone number, available date and time to perform the study and the name of an assistant that can help me coordinate the study.…

I selected your program from a list provided by OPH executives of programs that are implementing or have implemented process improvement initiatives. The purpose of the study is to compare the perceived current maturity level and desired Lean state of the program between managers and critical staff. The results of the survey can be used to identify the gaps between them that may affect the performance of the program and the association of Lean initiatives on those gaps. This study has been approved by the LSU institutional review board (IRB). All information provided during the research will be held in confidence and the program name or participant's name will not appear in any report or publication of the research.

A benefit of participating in this study is that you can request a SWOT (Strengths, weaknesses, opportunities and threats) analysis of your program developed by the author of the research to identify the weaknesses and strengths of your program and identify potential areas for improvement if you agree to do so. In addition, the results of the study will benefit public sector institutions that plan process improvement initiatives by providing knowledge of 1) the impact of such initiatives on the employees' maturity level and 2) how the initiatives may align their priorities and values to have better performance in achieving a common goal. Last, participating in this study will help me fulfill my graduation requirements.

If you agree to participate, please respond to this email (pomara1@tigers.lsu.edu) with your phone number, available dates and times to perform the study and the name of an assistant that can help me coordinate the study (if necessary). Again, I would like to thank you in advance for your time and consideration.

If you have any questions or concerns about the study you are free to contact me or my supervisor, Dr. Laura Ikuma at likuma@lsu.edu.

Thank you so much,

Participant Recruitment Email Text

Hello!

My name is Patrick O'Mara, graduate student from the Mechanical and Industrial Engineering Department at LSU. I am conducting research which involves employees of OPH programs that take part in improvement initiatives. I would be very grateful if you could participate in my study by agreeing to complete a 55 question survey designed to last 30 to 45 minutes. To minimize any inconvenience to your workday, I can schedule this survey any time and visit you personally to give the survey. To participate, please email me at pomara1@tigers.lsu.edu with your phone number and possible dates and times to perform the study.

The purpose of the study is to compare the perceived current maturity level and desired Lean state of the program between managers and critical staff. The results of the survey can be used to identify the gaps between them that may affect the performance of the program and the association of Lean initiatives on those gaps. This study has been approved by the LSU institutional review board (IRB). All information provided during the research will be held in confidence and the program name or participant's name will not appear in any report or publication of the research.

The results of the study will benefit public sector institutions that plan process improvement initiatives by providing knowledge of 1) the impact of such initiatives on the employees' maturity level and 2) how the initiatives may align their priorities and values to have better performance in achieving a common goal. Last, participating in this study will help me fulfill my graduation requirements.

If you agree to participate, please respond to this email (pomara1@tigers.lsu.edu) with your phone number and available date and time to perform the study. Again, I would like to thank you in advance for your time and consideration.

If you have any questions you are free to contact me or my supervisor, Dr. Laura Ikuma at likuma@lsu.edu.

Thank you so much.

APPENDIX D: DEMOGRAPHICS QUESTIONNAIRE

Part I. Demographic information

Instructions: Please answer the following questions. These questions are for data grouping purposes and the information obtained will remain anonymous. We appreciate your answers on all questions, but you may skip any questions you do not wish to answer.

Question	Answer
1. What program do you currently work for?	
2. Years working in the program	a. 0-2 years
	b. 2-5 years
	c. 5-10 years
	d. 10+ years
3. What is your role in the program?	a. Non-Supervisor: You do not supervise other employees.
	b. Supervisor: You are responsible for employees´ performance appraisals and approval of their leave, but you do not supervise other supervisors.
	c. Manager: You are in management position and supervise one or more supervisors.
	d. Executive: Member of the Senior Executive Service or equivalent.
4. Years of experience in private sector?	a. 0-2 years
	b. 2-5 years
	c. 5-10 years
	d. 10+ years
5. Years of experience in the public sector	a. 0-2 years
	b. 2-5 years
	c. 5-10 years
	d. 10+ years
6. How would you rate your familiarity with Lean tools and techniques?	a. No knowledge
	b. Poor
	c. Moderate
	d. Very Good
	e. Excellent

(Appendix D continued)

Question	Answer	
7. What percent of your time do you spend working on Lean six sigma (Process improvement) projects		
8. How many Lean projects have you been involved in?	a. 0	
	b. 1	
	c. 2	
	d. 3	
	e. 4	
	f. more than 5: _____	
9. Identify all barriers that you have found for the implementation and sustainability of Lean six	a. Management support	
	b. Organizational culture	
	c. Lack of strategy and communication	
	d. Lack of training	
	e. Other: _____	
9. Circle all Lean practices or tools that have been used in your program. **Rank your perceived impact of the tool on the organization on the cell to the right of the tool.** **(1 is little impact and 5 is big impact in the program)**	a. 5S	**1 2 3 4 5**
	b. Kaizen	**1 2 3 4 5**
	c. Visual Stream Mapping (VSM)	**1 2 3 4 5**
	d. Six Sigma	**1 2 3 4 5**
	e. Standardized work	**1 2 3 4 5**
	f.Total Quality Management(TQM)	**1 2 3 4 5**
	Other practice:	**1 2 3 4 5**
		1 2 3 4 5

Thank You for Participating!!

APPENDIX E: GOVERNMENT LEAN ENTERPRISE SELF-ASSESSMENT TOOL (GLESAT)

Survey ID:_____

1. Survey: Government Lean Self-Assessment Tool

Instructions: Please score each practice on two dimensions. First, provide a current score (C) based on your perception of the enterprise's present performance. Each practice has five capability levels that provide guidelines and evidence to help assess the appropriate score. Next provide a desired score (D) based on what the enterprise should achieve after the predetermined period (often, the time selected aligns with the enterprise strategic planning process). The intention is not to set all desired scores at the highest possible capability level but to prioritize those practices that you think are both achievable and have a high payoff.

Key Guidelines:

1. Attempt to assess every practice; leave a blank only if it is not applicable or if you do not know
2. For the current level of each practice mark the box labeled "C". For the desired level, mark the box labeled "D"
3. Read each practice from left to right starting with the practice and indicator. When scoring a practice, every capability level assumes that all lower capability levels have been fulfilled (i.e., you should only select level three if you meet the criteria set out in level two as well).
4. If you believe the enterprise is between levels, select the lower level
5. When possible note evidence for the current capability level selected.
6. Identify opportunities to achieve the desired capability level
7. If you have questions, seek clarification or assistance from the assessment facilitator

Section I: Lean Transformation/Leadership

Part I.A. Enterprise Strategic Planning

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.A.1	**Integration of Lean in Strategic Planning Process** Lean impacts value delivery in terms of cycle time and capability C D	Concepts and benefits of lean principles and practices are not evident in culture or strategic plans. C D	Lean is recognized, but relegated to lower levels of the enterprise and application is fragmented. C D	The value implications of lean are understood and lean implementation plans are formulated, but not integrated into the strategic plan. C D	Transitioning to lean is adopted as a key enterprise strategy and included in the strategic plan. C D	Strategic plans leverage the results of lean implementation to achieve shorter cycle times and affordable capability. C D
	Lean Indicators (Examples)	**• Lean implementation is included explicitly in the enterprise strategic plan.** **• Strategic planning makes allowance for anticipated gains from lean improvements.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.A.2	**Focus on Customer Value** Customers pull value from enterprise value stream	Means of defining value to customer(s) is informal and unstructured. C D	Structured process for defining value is applied to selected customers. C D	How the enterprise can best contribute to customer's success is well defined and incorporated into most projects/programs. C D	Customer definition of value strongly influences the strategic direction. C D	Enterprise processes are enhanced, as customer value becomes the predominant driving force throughout the extended enterprise. C D
	Lean Indicators (Examples)	**• Enterprise employs a formal process for determining customer value.** **• The enterprise understands what constitutes success for its customers.** **• A formal process exists to measure and assess customer satisfaction.** **• Customer value strongly influences policies, practices, and behavior.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.A.3	**Leveraging the Extended Enterprise** Value stream extends from customer through the enterprise to supporting organizations	Relations between organizations reflect a "we-they" mentality. C D	Initial opportunities identified for establishing extended enterprise linkages. C D	Strategic planning process explicitly includes consideration of key stakeholders in value streams. C D	Integration and balancing of stakeholder values are achieved via collaborations between supporting organizations and strategic partnering. C D	Integration of the extended enterprise contributes to innovation, value delivery, responsiveness and affordable capability. C D
	Lean Indicators (Examples)	**• Strategic planning is strongly influenced by stakeholder and customer value.** **• Strategic planning encompasses the total enterprise, including customer, alliances/partners, employees, and supporting organizations.** **• Risk and responsibilities are apportioned when leveraging the extended enterprise partners.**				
	Evidence					
	Opportunities					

Part I.B Adopt Lean Paradigm

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.B.1	**Learning and Education in "Lean" for Enterprise Leadership** "Unlearning" the old, learning the new C D	Little interest in learning lean principles is evident among enterprise leadership. C D	Leaders are actively seeking opportunities to learn about lean. There is an initial grasp of the extent of the paradigm shift for the enterprise. C D	The leaders are adopting lean learning and continuously applying lean principles across the enterprise. C D	Leaders contribute to the development or refinement of the body of knowledge about lean. C D	Lessons learned in implementing lean are actively shared across the organization and within the extended enterprise. C D
	Lean Indicators (Examples)	**• A formal lean education process for senior leaders has been established.** **• Majority of enterprise leaders have received significant exposure and education in lean principles, practices and behavior.** **• Leaders regularly apply and use lessons learned in lean.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.B.2	**Senior Management Commitment** Senior management leading it personally	Level of commitment among senior leaders and management is variable – some endorse while others may actively resist. C D	Senior management buys into group commitment; senior leaders / managers who cannot or will not adapt are replaced. C D	Lean is integral to enterprise-wide meetings, senior staff meetings, etc.; senior managers personally and visibly lead lean transition. C D	Senior leaders are championing the transformation to lean within the enterprise. C D	Senior leaders and management mentor and foster lean champions internally and throughout the extended enterprise. C D
	Lean Indicators (Examples)	**• There is a consensus commitment supporting a transformation to lean.** **• Management provides support and recognition for positive actions** **• Senior management are champions in transforming the enterprise.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.B.3	**Lean Enterprise Vision** New mental model of the enterprise	Senior leaders have varying visions of lean, from none to welldefined. C D	Senior leaders adopt common vision of lean. C D	Lean vision has been communicated and is understood by most employees. C D	Common vision of lean is shared by the extended enterprise. C D	Stakeholders have internalized the lean vision and are an active part of achieving it. C D
	Lean Indicators (Examples)	**• The role that lean plays in achieving the vision is clearly defined.** **• The vision has been communicated to all levels and has extensive buy-in by most employees.** **• The vision incorporates a new mental model of how the organization would act and behave according to lean principles and practices.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.B.4	**A Sense of Urgency** The primary driving force for lean	Scan of environment identifies competitive threats to responsiveness and need for action. C D	Enterprise senior leaders develop an urgent and compelling case for the lean transformation. C D	Urgent and compelling case for lean transformation has been communicated and the organization rallies behind it. C D	Urgent and compelling case for lean is expanded to and accepted by key supporting organizations. C D	Urgent and compelling case for lean is expanded to and accepted throughout the extended enterprise. C D
	Lean Indicators (Examples)	**• A compelling case for lean has been developed and communicated.** **• The implications and time scales of the vision have been translated for each area of the enterprise.** **• Lean transformation progress is integral to leadership discussions and events.**				
	Evidence					
	Opportunities					

Part I.C Focus on the Value Stream

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.C.1.	**Understanding the Current Value Stream** How we now deliver value to customers C D	The documented process flow differs from the actual flow. There is an initial understanding of the need for formal mapping and analysis. C D	Key stakeholders and what they value are identified. Present processes are mapped and initial analysis is underway. C D	Principal current value stream(s) are defined, allowing the identification of critical interactions. Significant opportunities for eliminating waste and creating value are identified and aligned with the strategic objectives. C D	Depth and breadth of knowledge of value stream elements and supporting processes exposes interdependencies across the enterprise. C D	Updated value streams and their independencies are evaluated across the extended enterprise. C D
	Lean Indicators (Examples)	**• A formal process has been established for identifying customer and stakeholder value.** **• The practice and language of value stream mapping is recognized as an important part of an iterative improvement process.** **• Current value streams of major customers/product lines have been mapped, and hand off points and interfaces clearly defined.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.C.2.	**Enterprise Flow** "Single piece flow" of materials and information	Material and information flows are disjointed and optimized process by process. "Push" mentality prevails. C D	Some primary flow paths have been overhauled to overcome significant barriers to flow. C D	Primary flow paths are simplified and aligned to the value stream(s), which allows information and material to flow as required. C D	Material and information flow seamlessly throughout the enterprise. C D	Material and information flow seamlessly and responsively throughout the extended enterprise. C D
	Lean Indicators (Examples)	**• Information flows have been rationalized to assure interoperability among enterprise elements.** **• Material flow paths have been simplified and shortened to enhance flow.** **• Information and material flows are responsive to stakeholder needs.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.C.3.	**Designing the Future Value Stream** Value stream to meet the enterprise vision	Management understands that the present processes do not meet the future lean enterprise objectives. C D	A concept for future value stream(s) design has been created based on balanced stakeholder requirements. C D	Future value stream(s) are developed, which encompass future enterprise goals and satisfy stakeholder requirements. C D	Future value stream(s) are refined to accommodate a changing environment. C D	Future value stream(s) are refined to dynamically accommodate a changing environment across the extended enterprise. C D
	Lean Indicators (Examples)	**• A formal process has been established to identify how the enterprise can best deliver value to customers and stakeholders.** **• The future value stream(s) reflects new and improved ways to realize value and minimize non-value adding activities.** **• Future value stream(s) designs have been generated for the primary value stream(s) and their supporting processes.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.C.4.	**Performance Measures** Performance measures drive enterprise behavior	Performance measures are ad hoc, inconsistent and focused on functional areas rather than value streams. C D	Baseline performance measures are established to stimulate progress towards the lean future state and are visible throughout the enterprise. C D	Performance measurement system uses a minimal and balanced set of measures based on strategic objectives and aligning local with enterprise metrics. C D	Measurement systems and target-setting pulls performance improvement throughout the enterprise. C D	A common targetsetting and measurement process pulls performance improvement across the extended enterprise. C D
	Lean Indicators (Examples)	**• A balanced and minimal set of performance measures are used to track lean implementation progress towards the strategic direction.** **• Performance measures used assure that local and enterprise measures are aligned.**				
	Evidence					
	Opportunities					

Part I.D. Develop Lean Structure and Behavior

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.D.1.	**Enterprise Organizational Orientation** Organize to support value delivery C D	The enterprise operates as functional or team silos. C D	Initial efforts are underway to identify functional or team barriers and understand their full implications. C D	Partially deployed crossfunctional/cross-team processes are aligned with enterprise value stream(s). C D	Extensive crossfunctional/ cross-team processes are implemented across the enterprise. Functional units now serve as knowledge centers for skill retention. C D	Cross-functional/cross-team, process-based orientation is aligned across the extended enterprise. C D
	Lean Indicators (Examples)	**• Functional/team barriers have been minimized.** **• There is extensive use of cross-functional/cross-team processes across the enterprise.** **• Career progression potential exists across both processes and functions.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.D.2.	**Relationships Based on Mutual Trust** "Win-win" vs. "wethey"	Relationships tend to be determined by organizational role, resulting in a “wethey” perspective. C D	Selective application of enterprise perspective results in breaking down of organizational barriers and developing mutual trust. C D	Stable and cooperative relationships exist across the enterprise; cooperative relations are established with some enterprise partners. C D	Mutual respect and trust exists across the extended enterprise with equitable sharing of benefits from continuous improvement initiatives. C D	Stakeholders modify behavior so as to enhance extended enterprise performance (win-win). C D
	Lean Indicators (Examples)	**• Communication barriers based upon organizational position have been significantly reduced.** **• Stable and cooperative relationships exist among most enterprise stakeholders.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.D.3	**Open and Timely Communications** Information exchanged when required	Communication is largely top-down, limited and lagging. C D	Basic communication mechanisms are employed but are not uniform; communication strategy is under development. C D	Enterprise leaders are accessible and visible, developing two-way communications in open, concise and timely form. C D	Communication processes are undergoing continuous refinement and information is exchanged or can be pulled as required. C D	Comprehensive system of two-way communication is employed throughout the extended enterprise. C D
	Lean Indicators (Examples)	**• Open and timely communications exist among stakeholders (i.e., regular meetings with employees, newsletters, etc.)** **• Technology has been leveraged to speed communications flow and accessibility, while filtering unnecessary communications.** **• Employee input is valued and plays a key part in decision-making.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.D.4.	**Employee Empowerment** Decision-making at lowest possible level	Centralized decisionmaking occurs in a hierarchical structure with limited delegation of authority. C D	Appropriate structure and training is being put in place to enable empowerment. C D	Organizational environment and management system supports limited decisionmaking at point of application and need. C D	Decision processes are continually refined to promote increased accountability and ownership at point of use. C D	Decision-making across the extended enterprise is delegated to the point of application. C D
	Lean Indicators (Examples)	**• Managers and supervisors serve as mentors and educators, promoting lower level decision-making.** **• The extent and types of empowerment are tailored to match the environment and people empowered.** **• Empowerment enables swift and effective decision-making closest to the point of use.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.D.5.	**Incentive Alignment** Reward the behavior you want	There is sporadic use of incentives and an awareness that some incentives discourage lean behavior. C D	Incentives that reward and encourage lean behavior are deployed in some areas. C D	Organizational leader performance reviews and employee incentives are linked directly to attainment of lean objectives. C D	Incentive systems successfully contribute to achievement and sustainability of lean objectives. C D	Lean incentives are deployed, with measurable success across the extended enterprise. C D
	Lean Indicators (Examples)	**• Incentives include a balance of money and non-monetary rewards / recognition to encourage lean activity.** **• Incentives are based on performance measures that encourage lean activity.** **• Incentives encourage local improvements that will benefit multiple processes or value steam performance.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.D.6	**Innovation Encouragement** From risk aversion to risk rewarding	Innovation initiatives are sporadic and ad hoc; security, stability and risk aversion drive most decisionmaking. C D	Initial efforts are underway to develop systems, processes and procedures for fostering innovations. C D	Innovation initiatives are underway in selected areas; measures for assessing impact are in use. C D	Innovation initiatives are flourishing across the enterprise; prudent risk taking is encouraged and rewarded. C D	Comprehensive innovation program is implemented and positive results recognized across the extended enterprise. C D
	Lean Indicators (Examples)	**• The review process for suggestions has been streamlined and gives clear visibility of the progress of each suggestion.** **• Suggestion programs have been properly incentivized to give recognition to originators of innovative ideas.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.D.7.	**Lean Change Agents** The inspiration and drivers of change	Change agents are sporadically distributed, but without change authority. C D	There is formal identification of change agents, along with role definition, authority delegation and program of education and training for change agents. C D	Appropriately skilled change agents are assigned to key areas with the authority to effect changes. C D	Change becomes selfgenerating, initiated by employees as well as change agents. C D	Change agents are providing a critical resource of lean knowledge, skill and experience in transforming the extended enterprise. C D
	Lean Indicators (Examples)					
	Evidence					
	Opportunities					

Part I.E. Create and Refine Transformation Plan

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.E.1.	**Enterprise-Level Lean Transformation Plan** Charting the course across the extended enterprise C D	Individual planning efforts are mostly bottom up initiatives with little priority or coordination established at enterprise level. C D	Enterprise-level view identifies lean implementation projects, which are prioritized to meet long and shortterm strategic objectives. C D	Enterprise improvement plans are coordinated and prioritized across enterprise value stream(s), with a timeline for expected measurable results. C D	Lean transformation plan is continuously refined through learning from implementation results and changing strategic requirements. C D	Lean transformation plan balances mutual benefits of stakeholders across the extended enterprise. C D
	Lean Indicators (Examples)	**• A process is in place to incorporate lessons learned into the enterprise-level lean transformation plan.** **• The milestone targets of the lean transformation plan are broken-down by section and deployed across the enterprise.** **• Plans balance long-term and short-term stakeholder objectives for the best overall solution.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.E.2.	**Commit Resources for Lean Improvements** Resource provision for lean	Little or no resources are provided for process improvement or waste elimination. C D	Limited enterprise-level resources are committed and often applied to the symptom rather than the root cause. C D	Resources are allocated as required for execution of the lean transformation plan and prioritized across the value stream. C D	A pool of earmarked resources is provided for lean initiatives with minimal justification required. C D	A pool of earmarked resources is provided for lean initiatives across the extended enterprise. C D
	Lean Indicators (Examples)	**• Resources are committed to support the level and speed of lean transformation required.** **• Time to build on improvements by personal contribution is given at all levels.** **• The procedure to apply for improvement resources has been simplified, and gives priority to improvements that benefit multiple areas.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.E.3.	**Provide Education and Training** Just-in-time learning	There is little coordination of education and training programs to facilitate change. C D	Education and training covers a set of skills required to support the lean transformation projects. C D	Education and training program is comprised of a balanced and sequenced set of elements to support the coordinated transformation plan. C D	Education and training at all levels is periodically reviewed to check alignment and suitability to the lean transformation plan. C D	Education and training program supports the upcoming needs of the extended enterprise transformation plan. C D
	Lean Indicators (Examples)	**• Education and training programs, including refreshers, are provided on a just-in-time basis.** **• Education and training has a balanced and sequenced set of elements to support the lean transformation plan.** **• The application of lean principles learned in training and education is formally appraised.**				
	Evidence					
	Opportunities					

Part I.F. Implement Lean Initiatives

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.F.1.	**Development of Detailed Plans Based on Enterprise Plan** Coordinating lean improvements	Improvements are generally optimized for individual areas and employees cannot clearly see the links between localized and enterprise goals. C D	Key goals of the enterprise lean transformation plan are understood by most employees. Process owners are involved in developing detailed plans linked to the goals/strategic objectives of the enterprise plan. C D	Detailed lean implementation plans supporting the enterprise level plan are developed and coordinated across processes. C D	Detailed lean implementation plans accounting for any interdependencies are refined and integrated across the enterprise. Best practices are shared. C D	Implementation plans from extended enterprise are coordinated with and support the lean transformation plan. C D
	Lean Indicators (Examples)	**• Detailed implementation plans are aligned to milestone targets of the enterprise-level plan.** **• A process is in place to incorporate lessons learned in detailed implementation plans.** **• Detailed improvement plans are coordinated throughout the enterprise where shared implications exist.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.F.2.	**Tracking Detailed Implementation** Assessing actual outcomes against goals	Results of process improvement initiatives are observed but not quantified. C D	Process is under development to permit tracking and quantification of progress of the detailed lean implementation. Data from some projects is being reviewed. C D	There is a project management process implemented to track progress of detailed lean projects against milestones, with feedback provided to enterprise level. Appropriate corrective action is initiated within individual projects. C D	The project management process can readily assess detailed plans and can accommodate revisions mandated by changes to the enterprise level lean transformation plan. C D	The project management process is deployed across the extended enterprise to enable real-time tracking. C D
	Lean Indicators (Examples)	**• Lean initiatives are coordinated and tracked, with the individual results "rolled up" and assessed against enterprise-level milestones and targets.** **• Responsibility and accountability for improvement success is assigned locally to enable fast corrective action on deviations from the plan.** **• Changes to processes/value stream map(s) are documented and updated regularly.**				
	Evidence					
	Opportunities					

Part I.G. Focus on Continuous Improvement

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.G.1.	**Structured Continuous Improvement Processes** Uniformity in how we get better C D	Improvement initiatives are ad hoc and not data driven. C D	An improvement process for the enterprise is broadly defined and being selectively applied. C D	Systematic, structured methodology for continuous improvement and value creation is developed and deployed across many areas. C D	Structured continuous improvement process is deployed at all levels across the enterprise, using value analysis to target improvements. C D	Structured continuous improvement process is fully ingrained throughout the extended enterprise. C D
	Lean Indicators (Examples)	**• A consistent improvement/transformation approach is implemented, sustaining improvements gained.** **• The continuous improvement process challenges people to tackle the root cause, rather than the symptom.** **• Lean principles are being applied to most enterprise systems and processes, utilizing lessons learned.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.G.2.	**Monitoring Lean Progress** Assessing progress toward achieving enterprise objectives	Enterprise leaders are not actively involved in the review of overall lean implementation plan progress. C D	Implementation plan progress is reviewed against enterprise level milestones and success criteria, for some projects. C D	A formal methodology is used by enterprise leaders to analyze the overall progress across all lean implementation projects. Current plans are adjusted based on learning from lean implementations. C D	Results of implementation projects are aggregated to permit reallocation of resources and to ensure on-going alignment with strategic objectives. C D	Senior managers monitor lean progress throughout the extended enterprise. Results are impacting future enterprise strategic planning. C D
	Lean Indicators (Examples)	**• Lean transformation progress is judged by the aggregate benefits, not individual or localized improvements.** **• Leaders actively participate in monitoring implementation progress and addressing deficiencies within the transformation plan.** **• Lean progress reviews are documented in a common format and disseminated.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.G.3.	**Nurturing the Process** Assure senior leaders' involvement	There is growing awareness that successful lean implementation is highly dependent upon senior management support and encouragement C D	Some senior managers are providing encouragement, support and recognition, which is not consistent across the enterprise. C D	Managers seek to identify and remove barriers to lean implementation. Teams and individuals who successfully implement lean practices are recognized and rewarded. C D	Senior managers across the entire enterprise are highly visible in their involvement, support and encouragement of the lean initiative. An enthusiastic atmosphere is evident. C D	Senior leaders and managers champion and nurture a culture of continuous improvement in the extended enterprise. C D
	Lean Indicators (Examples)	**• Management actively supports and is involved in ensuring the success of improvements.** **• Positive actions and the effort taken are recognized and rewarded, even if improvements are not fully successful.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.G.4.	**Capturing Lessons Learned** Ensuring that successes lead to more successes	Lessons learned from improvement activities are not documented, residing only in the memories of participants. C D	Lessons learned in some areas are documented and maintained in paper files, design rulebooks, etc. C D	A formal process for readily capturing and communicating lessons learned is being applied. Employee contributions are actively sought. C D	Lessons learned are consistently captured, communicated and regularly used in a structured manner. An enterprise knowledge base is created. C D	A formal knowledge management process is adopted. Lessons learned are routinely and explicitly incorporated into the formulation of new lean initiatives. C D
	Lean Indicators (Examples)	**• "Best" practice, suggestions and lessons learned are maintained in a concise and clear standard format.** **• A formal process has been established throughout the enterprise for capturing and reusing lessons learned.** **• Lessons learned are periodically reviewed to maintain relevance of information kept.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.G.5.	**Impacting Enterprise Strategic Planning** Results lead to strategic opportunities	Results of lean implementation are not fed back to strategic planning process. C D	Benefits of lean implementation are beginning to influence the strategic planning process. C D	Senior management considers potential impact of performance improvement initiatives in its assessment of new organizational or program opportunities. C D	Forecasted improvements from lean implementation are incorporated into enterprise planning and budgeting decisions. C D	Senior management integrates forecasted future results of lean implementation in its assessment of new opportunities and future organizational needs. C D
	Lean Indicators (Examples)	**• Business results reflect improvements resulting from lean implementation.** **• Strategic planning makes allowance for anticipated gains from lean improvements.** **• Gains realized from lean implementation are leveraged to achieve growth, profitability, market position and employment stability.**				
	Evidence					
	Opportunities					

Section II: Life Cycle Processes

Part II.A. Set-up the Enterprise

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.A.1	**Leverage Lean Capability for New Opportunities** Exploiting new opportunities arising from lean enabled capabilities C D	Improvement initiatives are ad hoc and are focused on operational efficiency. C D	Improvement gains provide resources to facilitate future improvements. Potential opportunities from applying lean thinking across core competences are recognized and plans have been developed. C D	Benefits sustained from applying lean thinking within the enterprise are used to retain current capabilities and/or develop new opportunities C D	There is full use of the enhanced capabilities and customer knowledge throughout the enterprise to leverage opportunities for providing greater value to customers. C D	The strategic plan dynamically incorporates extended enterprise capabilities and stakeholder interests to identify and leverage opportunities. C D
	Lean Indicators (Examples)	**• Reduced cost, increased quality and faster response times from waste eliminated are used to maintain or develop new opportunities.** **• The ability to improve and refine processes quickly is used extensively to respond to changing customer requirements.** **• A process is used to scan the environment to exploit opportunities arising from the enhanced capabilities of the lean enterprise.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.A.2.	**Optimize the Capability and Utilization of Assets** (people, equipment, facilities, etc.) Lean enables mission growth through the redeployment of assets	Utilization of people and material assets is optimized within functional/team units. C D	There is evidence of ad hoc cooperation between functional/team units to eliminate waste and share resources. C D	An enterprise approach provides consistent and balanced asset allocation across the value stream. C D	As a result of the application of lean concepts and techniques, assets are freed up to be applied across the enterprise to support current or growth activities. C D	The ability exists to easily and quickly shift or divest resources to new opportunities. C D
	Lean Indicators (Examples)	**• Assets freed up from lean implementation are readily redeployed.** **• Workforce and its knowledge is nurtured, reallocated and maintained where possible.** **• Available assets and resources are coordinated throughout the enterprise to leverage resources to the maximum.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.A.3.	**Provide Capability to Manage Risk, Cost, Schedule and Performance** Success follows effective risk management	Programs/projects are managed and staffed as independent entities. C D	There is a management system to monitor and control program/project performance and staffing. Regular reviews focus on cost, schedule and performance of individual programs/projects. C D	Reviews assess risk within individual programs/projects and staffing is adjusted as necessary to mitigate risk. C D	The programs/projects are reviewed assessing the risk across the portfolio of programs/projects with appropriate reallocation of resources. C D	Risk abatement processes are used to optimize performance of the portfolio of programs/projects. C D
	Lean Indicators (Examples)	**• Program/project and process reviews have a portfolio approach to achieve enterprise balance.** **• A risk management process is fully integrated across the enterprise.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.A.4	**Allocate Resources for Program/Project Development Efforts** Teaming for success	Program/project development efforts rely on functional units for allocation of the required skills. C D	Some but not all skills /resources necessary are dedicated and assigned to program development. Skilled resources are narrowly guarded within programs/projects. C D	Some of the skilled resources are routinely shared across programs/projects. Formal methods are being developed for determining team makeup and assignment of necessary skills. C D	Resources and skills are routinely balanced and shared across the portfolio of programs/projects. C D	"Virtual organizations" are created as needed from the extended enterprise and provided with the skills and resources necessary to execute the development effort(s). C D
	Lean Indicators (Examples)					
	Evidence					
	Opportunities					

Part II.B. Build Relationships

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.B.1	**Define and Develop Relationships with Stakeholders** Aligning stakeholder values through relationships that build credibility C D	Some stakeholders have been identified and relationships are based on situational necessity. C D	Temporary relationships are established with major stakeholders to support upcoming events. C D	Relationships are developed and maintained with key stakeholders throughout the life cycle. There is a plan or process to engage other stakeholders in the product/service value chain. C D	Relationship building is a key program/project strategy. Stakeholder relationships are nurtured over time and foster high enterprise credibility. C D	Relationships have been established across the extended enterprise, are selfsustaining, and result in widespread stakeholder trust. C D
	Lean Indicators (Examples)	**• Relationships are defined and developed in line with the enterprise strategic plan to ensure efficient creation of value for the extended enterprise.** **• Stakeholders in the extended enterprise value the relationships established.** **• Robust relationships provide stakeholders the ability to adapt to changing requirements and unanticipated disruptions.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.B.2.	**Optimize the Relationship** Creating effective relationships to achieve customer value	Relationships are at arm's length and adversarial. Relationships are defined only by contract language or formal agreements. C D	Beside the formal relationship agreements, objectives, roles and responsibilities are communicated informally between stakeholders. C D	Shared values are established and communicated in key stakeholder relationships, who are involved early in the design/development of relationship processes and program/project plans. C D	A seamless relationship is established between stakeholders that is dynamic to changes and provides insight into values of others, such that organizational boundaries become blurred. C D	Stakeholders in the extended enterprise balance competencies in their relationships for best program / service value. C D
	Lean Indicators (Examples)	**• Relationships focus on program/service life cycle value rather than organizational objectives.** **• Interactions between stakeholders are effortless.** **• Stakeholders balance capabilities for best value to the program/service.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.B.3.	**Foster Innovation and Knowledge-Sharing** Incentivizing innovation through stakeholder involvement	Primary focus on internal expertise, with little cognizance of tacit (experience-based) or explicit (formal) knowledge of other stakeholders. C D	Internal organizational structures and processes are established to leverage stakeholder knowledge and innovation. C D	Strategic planning includes stakeholders in pursuance of a common strategic vision. Shared metrics for continuous improvement are utilized. C D	Knowledge transfer mechanism is created for open and rapid access by all stakeholders. C D	Mutually beneficial arrangements to foster innovation between stakeholders. Process for communication of needed changes in vision, strategy, metrics, and implementation. C D
	Lean Indicators (Examples)	**• Long-term collaborative relationships are established and maintained where possible.** **• Processes to facilitate sharing and transfer of innovation, knowledge and technology are deployed.** **• A mutually beneficial continuous improvement process is established between stakeholders over the product/service life cycle.**				
	Evidence					
	Opportunities					

Part II.C. Develop the Plan

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.C.1.	**Establish a Requirement Definition Process to Optimize Life Cycle Value** Stakeholder pull vs. technology/product push C D	Requirements are defined internally based on past experience, rather than on a formal requirements definition process. C D	Requirements definition process, which balances cost, schedule and performance, is partially developed, deployed and documented. C D	Requirements definition process leverages value chain capabilities and focuses on overall life cycle implications. C D	An iterative requirements definition process spans the value chain resulting in a minimal set of requirements that balances cost and performance. C D	The requirements process is a strategic advantage for the extended enterprise contributing to increased responsiveness and new capabilities. C D
	Lean Indicators (Examples)	**• There is a process in place to determine clear and concise product and life cycle requirements, with acceptable ranges.** **• The process ensures a balanced representation from all stakeholders across the value chain.** **• Structured methods are used to elicit and gather needs from the different stakeholders/customers.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.C.2.	**Capture Data from Extended Enterprise to Optimize Future Requirement Definitions** Closed loop processes are in place to capture operational performance data	Ad hoc communication processes represent the primary source of data that is collected and analyzed for impacts to present requirements. C D	A proactive process is being developed to collect product/service usage data as the basis for future requirements. C D	Data are collected across the present value chain and used to feed future design solutions and requirement definitions. C D	Process allows real-time access, collection and dissemination of data from across the extended enterprise for analysis by stakeholders for future use. C D	The process is established across the extended enterprise to actively seek data on needs, usage and process capability to populate a data repository that can be mined for future requirements. C D
	Lean Indicators (Examples)	**• Customer feedback is actively sought and provided as input to the requirements definition process.** **• A product/service database is maintained and extensively used to establish future requirements definitions.** **• Enhanced knowledge of customer and stakeholder requirements and desires is used to leverage future requirements.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.C.3.	**Incorporate Stakeholder Value into Design of Products and Processes** Understanding stakeholder value facilitates fewer development perturbations	Stakeholder inputs are captured only at the beginning of the development. C D	Stakeholder inputs are considered qualitatively through top-level liaison and occasional reviews. C D	Stakeholder values are represented on Integrated Product Teams (IPT) and feedback mechanisms exist to facilitate timely design iterations. C D	Stakeholders are actively involved with IPT at multiple levels to jointly improve the effectiveness and quality of the product and process design. C D	Stakeholders involved with IPT in continuous communication. Sharing of benefits well established; value quantification and tradeoffs continuous, automatic part of process. C D
	Lean Indicators (Examples)	**• Stakeholders participate throughout the development process.** **• Designs satisfy stakeholder value requirements, without unnecessary functionality.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.C.4	**Incorporate Downstream Stakeholder Values into Products and Processes** Understanding downstream stakeholders allows value to flow seamlessly	Downstream activities are considered late in process. C D	Downstream activities are considered earlier in projects, but in an ad hoc manner. Cost considerations are limited. C D	Multi-functional teams include some downstream disciplines and key downstream stakeholders. C D	Priorities of downstream stakeholders are quantified as early as possible, and used for process evaluation and improvement. C D	Downstream stakeholders' values in the extended enterprise are quantified, and balanced via tradeoffs, as a continuous part of the process. C D
	Lean Indicators (Examples)	**• There is early consideration and incorporation of downstream stakeholders issues throughout product and process development.** **• The scope of considerations integrated into product and process development has been extended to include downstream activities and cost implications.** **• Processes flow with reduced cycle time and integrate upstream and downstream stakeholder values.**				
	Evidence					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.C.5.	**Create a Multidisciplinary Approach** Breaking down of functional silos enables seamless communication and value flow	Development is performed in functional organizations. C D	Multidisciplinary development is used to a limited extent. C D	Multidisciplinary development is used extensively; metrics are established for process evaluation. C D	Multidisciplinary techniques are deployed for most programs/product development efforts; metrics are used for process evaluation and improvement. C D	Product and process definition is seamlessly integrated both internally and with the upstream and downstream stakeholders. C D
	Lean Indicators (Examples)	**• Resources and skills are balanced across projects and programs, to aid maximum re-use and sharing of knowledge.** **• Suitability and timing of information released, is matched to the requirements of subsequent processes.**				
	Evidence					
	Opportunities					

Part II.D. Implement the Plan

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.D.1	**Utilize Knowledge and Capability in Decision Making** Strategic leveraging of stakeholder capability C D	Decision processes employ knowledge available at the time to address the current crisis or issue. C D	An informal decision process is in place that is used in some areas or under some conditions which draws knowledge from a broad set of experts to apply to the decision process. C D	Decision processes have been established which gather knowledge from many stakeholders to be used in a majority of decisions. It is not adverse to ask for help. C D	Decision processes are integrated with organizational strategic objectives and applied to a broad set of decisions. C D	Decision processes leverage the knowledge and capabilities of the extended enterprise and take into account the enterprise goals and objectives. C D
	Lean Indicators (Examples)	**• Decision making capability constitutes a major consideration in enterprise level long-range, strategic planning.** **• Knowledge is maintained and shared throughout the extended enterprise.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.D.2	**Foster Lean Behavior Throughout the Value Stream** Promoting stakeholder innovation and flexibility	Processes and relationships are established based on past/historical norms. C D	There are pockets within the value stream where the objectives of the task, program, or mission influence creation of new processes to maximize value. C D	All members of the value stream have established processes that foster open sharing of information with "no spin" assessments C D	Senior leadership involvement allows stakeholders to develop innovative approaches that are flexible to changing conditions. C D	Stakeholders along the value stream are empowered to develop flexible and innovative processes based on value delivered to the extended enterprise. C D
	Lean Indicators (Examples)	**• Conversion to lean has freed up resources for re-deployment.** **• Bottleneck have been identified and eliminated to allow processes to flow seamlessly.** **• Work is performed only when "pulled" from subsequent "customers" in the value chain.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.D.3	**Align Customer Requirements and Expectations with the Extended Enterprise Capabilities** Aligning customer and stakeholder expectations	New projects are started by aligning customer requirements with internal enterprise capabilities. Other stakeholders are not consulted or involved in this process. C D	An external stimulus drives the need to align key stakeholder capabilities with customer requirements. C D	Customers and key stakeholders work collaboratively to align capabilities and requirements on key project/process milestones. C D	Stakeholders actively engage with customers to align customer requirements and enterprise capabilities as a normal way of doing business. C D	Customers' actual and future requirements align in real-time with the extended enterprise's capabilities. C D
	Lean Indicators (Examples)	**• Stakeholder capabilities are aligned with current and future customer requirements.** **• Stakeholders and customers are engaged as indicated by constant communication to align capabilities with customer requirements.** **• Products/services are delivered as expected, on-time and without unplanned Herculean efforts or rework on the part of some stakeholders.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.D.4	**Transition Product/Service to the Customer** Right product for a ready customer that meets all stakeholder requirements	Primary focus is program/service completion, with insufficient emphasis on customer transition activities. C D	There is an internal activity considering the customer transition. Activities are limited to rehashing existing plans. C D	Customers and key stakeholders are active as contributors and reviewers of internally developed transition plans. C D	Customers and key stakeholders actively collaborate to develop and execute transition activities. C D	There is a seamless transition of product/service to customer with all stakeholders aligned to support the customer. C D
	Lean Indicators (Examples)	**• The customers collaborate early in product/service development and are supported after the delivery of the product/service.** **• Support such as training, facilities, special equipment and other resources are in place in time for product/service delivery.** **• The transition to new product/service happens seamlessly without major perturbations.**				
	Evidence					
	Opportunities					

Part II.E. Learn, Improve, and Sustain

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.E.1	**Enhance Value of Delivered Products and Services to Customers and the Enterprise** Responding to the voice of the customer C D	Product/service support system reacts to customer needs, usually on-time and from inventory or internal resources. C D	Support system delivers products / services on time, but with disruptions to production flow and associated resources. C D	Support system flow paths are identified and are beginning to be integrated with lean product development and production flows. C D	Standardized customer and product support processes provide responsive information and product flow fully integrated with development and production flows. C D	Customer needs for post-delivery products / services are anticipated in enterprise plans and fulfilled by adaptation and extension of capabilities already provided. C D
	Lean Indicators (Examples)	**• Solutions to product / service issues are coordinated throughout the extended enterprise to find fast, cost effective solutions.** **• Customer and product support processes have been standardized and are regularly reviewed against customer feedback.** **• Disruptions to design and production flow from support services has been minimized.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.E.2.	**Provide Post Delivery Service, Support and Sustainability** Providing customer solutions	High level of spares or support necessary because of unknown failure rates, long lead times for spare replenishment or service incompatible with customer expectations. C D	Collection of deficiency data permits both determination of service and support levels for preventative activities and a reduction of spare part levels. C D	The enterprise is increasingly involved in addressing customer service/support solutions. Commonality is used to reduce spare part and support levels; root cause analyses are fed back into product design. C D	The enterprise is part of the customer's service/support solution by ensuring availability through replacement of critical components or support needs before failure or loss of capability. C D	The enterprise has become the customer's total system capability solution. Support and sustainment issues are addressed before they impact customer total system capability. C D
	Lean Indicators (Examples)	**• Customer feedback is proactively maintained and used to predict any emerging service issues and enhance future designs.** **• There is a close relationship between the enterprise and the customer organization.** **• The enterprise has internalized the customers total system capability needs and collaborates with the customers to ensure long term capability solutions.** **• Spares levels are reduced in line with short predicable lead times for replacement spares.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
II.E.3	**Maintain Challenge of Existing Processes** Ensure a culture of continuous improvement	Ad hoc feedback in progress with variable formats. Primary focus is on program or service delivery. C D	Lessons learned have been periodically gathered from key stakeholders. Even though lessons learned are collected in the enterprise known issues are experienced again. C D	Feedback is gathered at major milestones from the customer and key stakeholders. Lessons learned are effectively used to a varying degree across the enterprise. C D	Leaning is shared across the enterprise, among customers and between stakeholders. Within the enterprise learning takes place between projects throughout their life cycles. C D	Seamless integration of learning, robust to change that provides total system solutions across the life cycle for all stakeholders. C D
	Lean Indicators (Examples)	**• Lessons learned are shared across projects or over life cycle periods.** **• There is low problem or issue repetitions in the enterprise.** **• There is a central repository of lessons learned with robust user interfaces.**				
	Evidence					
	Opportunities					

Section III: Enabling Infrastructure

Part III.A Lean Organizational Enablers

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
III.A.1.	**Financial System Supports Lean Transformation** Lean requires appropriate financial data C D	Finance system provides basic budget and cost accounting data; there is little awareness and exploration of broader support roles for finance. C D	Initial efforts are underway to adapt or modify systems to compensate for the inadequacies of the formal financial system. C D	Finance system is overhauled to provide data and financial information to support and enable a lean transformation at any level. C D	Financial system scope is expanded to integrate with nontraditional measures of value creation (e.g., intellectual capital,balanced scorecard). C D	Financial systems provide seamless information exchange across the extended enterprise, with emphasis on value creation for all stakeholders. C D
	Lean Indicators (Examples)	**• Financial measures that conflict with lean activity are no longer used to measure progress and performance.** **• The financial system handles a balanced set of financial and non-financial measures to assist decision-making.** **• The financial system has been overhauled to ensure fast and efficient processing of information as required.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
III.A.2.	**Enterprise Stakeholders Pull Required Financial Information** Data on demand	Lagging financial information is reported through regularly scheduled standardized reports. Specific requests for measures require extraordinary effort. C D	Finance actively provides traditional financial information to assist users in planning and programming activities. C D	Users are able to directly access and use financial information to make trade-off decisions. C D	Users are able to pull financial and other value creation information to support decision analysis in the format desired. C D	Users across the extended enterprise generate and share timely financial and performance data. Data reflects extended enterprise results. C D
	Lean Indicators (Examples)	**• Financial and performance measurement data can be accessed as needed in user-defined format.** **• Financial information can be extrapolated to forecast outcomes.** **• System provides up to date information on request and rationalizes information no longer used.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
III.A.3.	**Promulgate the Learning Organization** Learning Organizations create a flexible workforce	The human resources processes concentrate on recruiting, placement and benefits. Personnel training is ad hoc and not aligned to organizational needs. C D	A well-defined personnel development process, aligned with organizational needs, is applied for selected employees. C D	Personnel development process is extended to all employees and incorporates the anticipated future needs of the enterprise. Resources and facilities are dedicated for learning. C D	A learning climate is promoted within the enterprise through ready access to information and input to strategy/policy making. Opportunities for extending learning experiences are provided. C D	A learning climate is promoted throughout the extended enterprise by the sharing of capabilities, knowledge, skills and best practice. C D
	Lean Indicators (Examples)	**• Intellectual capital is regarded as an asset.** **• Employees have individual training plans, which are aligned to the current and projected skill base requirements.** **• Employees actively capture and incorporate lessons learned into future training and practices.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
III.A.4.	**Enable the Lean Enterprise with Information Systems and Tools** Facilitate the flow of information and knowledge	The information infrastructure consists mainly of stand-alone systems. The need for systems integration is recognized but no improvement plan exists. C D	Elements of a common information infrastructure have been determined, and an implementation plan is under development. Maintenance of legacy systems consume most IT resources. C D	The information infrastructure has been formalized and is in use in selected locations. Legacy systems are rationalized and aligned across the value stream. C D	An information infrastructure is deployed that supports seamless information exchange across the enterprise. C D	Information systems are fully interoperable and the pertinent information is easily accessible and usable across the extended enterprise. C D
	Lean Indicators (Examples)	**• Compatible information systems and tools exist across the extended enterprise.** **• Information systems facilitate fast and effective transfer and retrieval of information required.** **• Information systems and tools complement lean processes and practices and are easily adapted to accommodate change.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
III.A.5.	**Integration of Environmental Protection, Health and Safety into the Enterprise** "Cleaner, healthier, safer"	The enterprise complies with all known legal and regulatory requirements and reacts if issues are identified. C D	Consideration is given to means of mitigating conditions that cause environmental, health and safety issues. C D	A process is in place to proactively identify Environmental protection, Health and Safety (EHS) risks and manage them appropriately, with a preference for source prevention. C D	Forward thinking solutions to potential life cycle EHS risks are implemented early in product (service) design and throughout the value stream. C D	EHS risk prevention and mitigation is part of the natural way business is conducted across the extended enterprise, creating a sustainable environment and creating a capability advantage. C D
	Lean Indicators (Examples)					
	Evidence					
	Opportunities					

Part III.B. Lean Process Enablers

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
III.B.1.	**Process Standardization** Strive for consistency and re-use C D	Processes vary by program or product line. C D	Key processes in the organization have been identified that could benefit from standardization, with initial efforts underway. C D	Selected processes are standardized across the enterprise. C D	Process standardization and reuse is consistently employed across the enterprise. C D	Extended enterprise interface processes have been standardized. C D
	Lean Indicators (Examples)					
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
III.B.2.	**Common Tools and Systems** Assuring compatibility, reducing costs	Tools and systems vary by program or work center. C D	Have identified high leverage opportunities for common tools and systems; initial deployment in a few areas. C D	Plans are in place for achieving common tools and systems and have been implemented to varying degrees across the enterprise. C D	Common tools and systems have been implemented throughout the enterprise. C D	Compatibility of tools and systems with those of enterprise partners in the extended enterprise. C D
	Lean Indicators (Examples)	**• Policies have been established and deployed that require the use of common tools and systems throughout the enterprise.** **• Common tools and systems provide easy access and reuse of knowledge across the product life cycle.** **• Enterprise-wide use of common tools and systems provides enhanced compatibility between processes and aids employee transfer.**				
	Evidence					
	Opportunities					

LP #	Lean Practices	Capability Levels				
		Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
III.B.3.	**Variation Reduction** Reduce uncertainty by reducing variation	There is limited use of variation reduction tools and methods. There is some evidence of variation understanding in parts of the organization. C D	There is evidence that sources of variation are being identified and analyzed. Initial efforts are underway to reduce variability. C D	A formal approach that balances customer value and variation reduction is implemented in many parts of the enterprise. C D	Considerable benefits are realized from reduced variation in processes and practices across the enterprise. C D	Benefits of reduced variation are realized across the extended enterprise. C D
	Lean Indicators (Examples)	**• Process ownership and visual displays of process variation enable quick and easy identification of adverse trends.** **• High levels of process stability are maintained by utilizing mistake proofing and root cause identification techniques to the fullest.** **• Variation reductions achieved enable short predicable lead times for information and material flow.**				
	Evidence					
	Opportunities					

APPENDIX F: GLESAT RESULTS DATA

SECTION 1 - LEAN TRANSFORMATION/LEADERSHIP

| TTL LINK | Lean Practice | | RESPONDENT/GROUP NUMBER | | |

SECTION II - LIFE CYCLE PROCESSES

| TTL LINK | Lean Practice | | RESPONDENT/GROUP NUMBER | | |

APPENDIX G: NON-LEAN GROUP ANALYSIS

SECTION 1 - LEAN TRANSFORMATION/LEADERSHIP

	Section X.X Averages		
TTL LINK	Current	Desired	Gap
I.A Enterprise strategic planning	1.7	3.6	1.9
I.B Adopt Lean Paradigm	1.2	3.1	1.9
I.C Focus on the Value Stream	1.7	3.3	1.6
I.D Develop lean Structure and Behavior	1.8	3.6	1.8
I.E Create and Refine Implementation Plan	1.5	3.2	1.8
I.F Implement Lean Initiatives	1.3	3.0	1.7
I.G Focus on Continuous Improvement	1.6	3.3	1.7

SECTION II - LIFE CYCLE PROCESSES

	Section X.X Averages		
TTL LINK	Current	Desired	Gap
II.A. Set-up the Enterprise	1.7	3.3	1.6
II. B. Build Relationships	2.0	3.6	1.6
II.C. Develop the Plan	1.9	3.4	1.6
II.D. Implement the Plan	1.7	3.4	1.7
II.E. Learn, Improve and Sustain	1.8	3.3	1.6

SECTION III - ENABLING INFRASTRUCTURE

	Section X.X Averages		
TTL LINK	Current	Desired	Gap
III.A. Lean Organizational Enablers	1.8	3.4	1.6
III.B. Lean Process Enablers	2.0	3.3	1.5

SECTION 1 - LEAN TRANSFORMATION/LEADERSHIP

								TALLYS		
TTL LINK	**Lean Practice**	**State**	**Mean**	**Variance**	**Range**	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.A Enterprise strategic planning	I.A.1. Integration of lean in strategic planning process	Current	1.1	0.7	3.0	15	2	2	0	0
		Desired	3.3	1.3	4.0	2	2	8	6	3
		Gap	2.2	0.8	3.0	4	11	4	2	0
	I.A.2. Focus on customer value	Current	2.0	0.8	2.0	5	4	8	0	0
		Desired	3.8	1.3	3.0	0	4	4	6	7
		Gap	1.8	0.8	3.0	6	8	3	1	0
	I.A.3. Leveraging the extended enterprise	Current	2.1	1.0	3.0	5	9	2	3	0
		Desired	3.7	0.7	3.0	0	1	8	7	4
		Gap	1.6	0.6	2.0	9	6	3	0	0
I.B Adopt Lean Paradigm	I.B.1. Learning and education in 'lean' for enterprise leaders	Current	1.8	0.6	4.0	2	15	0	1	0
		Desired	3.2	0.9	3.0	0	5	10	4	3
		Gap	1.5	0.5	3.0	9	7	2	0	0
	I.B.2. Senior management commitment	Current	1.2	0.6	3.0	7	5	1	0	0
		Desired	3.2	1.0	3.0	0	6	7	6	2
		Gap	2.0	1.1	4.0	6	7	5	0	1
	I.B.3 Lean Enterprise Vision	Current	1.0	0.3	2.0	9	3	0	0	0
		Desired	3.1	1.0	3.0	0	7	7	5	2
		Gap	2.1	1.0	4.0	5	8	6	0	1
	I.B.4. A sense of urgency	Current	1.0	0.5	3.0	14	3	1	0	0
		Desired	2.9	1.1	4.0	0	8	7	4	2
		Gap	1.9	0.9	3.0	10	9	2	2	0
I.C Focus on the Value Stream	I.C.1. Understanding the current value stream	Current	1.5	0.6	3.0	6	6	2	0	0
		Desired	3.1	0.6	3.0	0	4	12	3	1
		Gap	1.6	0.8	4.0	9	8	1	1	0
	I.C.2. Enterprise flow	Current	1.9	0.8	3.0	5	7	5	1	0
		Desired	3.4	0.8	3.0	0	3	10	6	3
		Gap	1.5	0.4	2.0	14	9	1	0	0
	I.C.3. Designing the future value stream	Current	1.5	0.9	4.0	9	6	2	1	0
		Desired	3.1	1.4	4.0	0	6	8	3	4
		Gap	1.6	0.5	2.0	8	8	3	0	0
	I.C.4. Performance measures	Current	1.9	1.2	3.0	10	6	2	3	0
		Desired	3.6	1.5	3.0	0	5	6	3	7
		Gap	1.8	0.9	3.0	6	8	1	2	0
I.D Develop lean Structure and Behavior	I.D.1. Enterprise organizational orientation	Current	2.0	0.9	3.0	6	6	7	1	0
		Desired	3.6	1.0	3.0	0	3	7	7	5
		Gap	1.6	0.4	2.0	11	9	2	0	0
	I.D.2. Relationships based on mutual trust	Current	1.6	1.0	4.0	10	4	4	1	0
		Desired	3.6	0.9	3.0	0	3	7	8	4
		Gap	2.0	1.2	4.0	10	5	6	0	1
	I.D.3. Open and timely communications	Current	2.2	1.1	3.0	6	7	5	3	0
		Desired	3.9	1.1	3.0	0	2	7	5	8
		Gap	1.7	0.5	3.0	9	12	0	1	0
	I.D.4. Employee empowerment	Current	2.4	1.2	4.0	1	8	6	4	0
		Desired	4.0	0.6	3.0	0	1	4	11	5
		Gap	1.5	0.6	3.0	9	8	2	0	0
	I.D.5. Incentive alignment	Current	1.2	1.0	4.0	12	3	1	1	0
		Desired	3.3	1.0	3.0	0	5	7	6	3
		Gap	2.1	0.9	3.0	7	8	5	2	0
	I.D.6. Innovation encouragement	Current	1.8	0.9	3.0	8	5	4	1	0
		Desired	3.6	1.0	3.0	0	3	7	7	4
		Gap	1.8	0.7	3.0	8	10	2	1	0
	I.D.7. Lean change agents	Current	1.3	0.8	3.0	5	5	2	0	0
		Desired	3.0	0.9	3.0	0	8	6	5	1
		Gap	1.7	0.5	3.0	10	11	0	1	0
I.E Create and Refine Implementation Plan	I.E.1. Enterprise level lean implementation plan	Current	1.5	0.7	3.0	11	5	3	0	0
		Desired	3.0	0.7	3.0	0	6	9	4	1
		Gap	1.6	0.7	3.0	11	7	1	1	0
	I.E.2. Commit resources for lean improvements	Current	1.5	0.6	3.0	4	11	1	0	0
		Desired	3.5	0.6	2.0	0	0	14	4	3
		Gap	2.0	0.8	3.0	10	10	2	2	0
	I.E.3. Provide education and training	Current	1.5	0.5	2.0	14	4	3	0	0
		Desired	3.2	1.3	3.0	0	8	4	6	3
		Gap	1.8	1.1	3.0	12	5	3	2	0
I.F Implement Lean Initiatives	I.F.1. Development of detailed plans based on enterprise plan	Current	1.3	0.5	3.0	12	4	2	0	0
		Desired	3.0	1.0	3.0	0	8	7	4	2
		Gap	1.7	0.4	2.0	5	10	2	0	0
	I.F.2. Tracking detailed implementation	Current	1.3	0.6	3.0	6	5	1	0	0
		Desired	3.0	0.8	3.0	0	6	7	4	1
		Gap	1.7	0.4	2.0	7	9	2	0	0
I.G Focus on Continuous Improvement	I.G.1. Structured continuous improvement process	Current	1.8	0.9	3.0	6	6	4	1	0
		Desired	3.3	0.8	3.0	0	4	9	6	2
		Gap	1.5	0.5	3.0	10	9	1	0	0
	I.G.2. Monitoring lean progress	Current	1.7	1.1	4.0	7	7	1	2	0
		Desired	3.1	1.2	3.0	0	7	6	3	3
		Gap	1.5	0.8	4.0	8	6	1	1	0
	I.G.3. Nurturing the process	Current	1.5	0.6	3.0	9	7	2	0	0
		Desired	3.5	1.3	3.0	0	5	5	5	5
		Gap	2.0	1.2	4.0	4	4	7	1	0
	I.G.4. Capturing lessons learned	Current	1.9	1.3	4.0	7	3	5	0	1
		Desired	3.8	0.9	3.0	0	2	6	7	5
		Gap	1.9	0.7	4.0	3	12	2	1	0
	I.G.5. Impacting enterprise strategic planning	Current	1.3	0.9	4.0	12	3	1	1	0
		Desired	3.1	0.9	3.0	0	6	8	3	2
		Gap	1.7	0.6	3.0	6	9	1	1	0

SECTION II - LIFE CYCLE PROCESSES

								TALLYS		
TTL LINK	**Lean Practice**	State	Mean	Variance	Range	Level 1	Level 2	Level 3	Level 4	Level 5
II.A. Set-up the Enterprise	II.A.1. Leverage lean capability for new opportunities	Current	1.5	0.5	2.0	10	6	2	0	0
		Desired	3.0	1.1	3.0	0	9	4	6	2
		Gap	1.6	0.7	3.0	10	7	1	1	0
	II.A.2. Optimise the capability and utilization of assets	Current	1.7	0.6	3.0	6	13	2	0	0
		Desired	3.3	1.1	4.0	0	3	10	5	3
		Gap	1.6	0.4	2.0	9	9	2	0	0
	II.A.3. Provide capability to manage risk, cost, schedule and performance	Current	1.7	1.0	3.0	11	5	2	2	0
		Desired	3.2	1.2	3.0	0	6	8	3	4
		Gap	1.5	0.5	2.0	9	7	2	0	0
	II.A.4. Allocate resources for program/project development efforts	Current	2.0	0.8	3.0	5	7	6	1	0
		Desired	3.7	0.8	3.0	0	2	6	9	4
		Gap	1.7	0.3	2.0	4	15	0	0	0
II. B. Build Relationships	II.B.1. Define and develop relationships with stakeholders	Current	2.0	1.0	3.0	8	7	4	2	0
		Desired	3.7	0.9	3.0	0	2	8	7	5
		Gap	1.7	0.6	3.0	5	11	1	1	0
	II.B.2. Optimize the relationship	Current	2.2	0.5	2.0	4	11	8	0	0
		Desired	3.7	0.7	3.0	0	1	9	8	4
		Gap	1.5	0.5	3.0	12	7	2	0	0
	II.B.3. Foster innovation and knowledge-sharing	Current	1.9	0.5	2.0	3	10	4	0	0
		Desired	3.5	1.2	3.0	0	4	7	5	5
		Gap	1.7	0.9	4.0	10	6	3	1	0
II.C. Develop the Plan	II.C.1. Establish a requirements definition process to optimize life cycle value	Current	1.7	0.9	3.0	7	5	3	1	0
		Desired	3.2	1.0	4.0	0	4	6	7	1
		Gap	1.4	0.7	3.0	9	6	2	0	0
	II.C.2. Capture data from the extended enterprise to optimize future requirement definitions	Current	2.1	0.9	3.0	4	8	2	2	0
		Desired	3.6	0.7	3.0	0	1	6	7	2
		Gap	1.6	0.3	1.0	4	10	0	0	0
	II.C.3. Incorporate stakeholder value into design of products and processes	Current	1.5	0.5	3.0	8	9	1	0	0
		Desired	3.1	0.4	2.0	0	3	11	5	0
		Gap	1.6	0.4	2.0	7	9	1	0	0
	II.C.4. Incorporate downstream stakeholder vlues into products and processes	Current	2.1	0.3	2.0	0	10	3	0	0
		Desired	3.8	0.6	2.0	0	0	6	5	3
		Gap	1.6	0.4	2.0	7	7	1	0	0
	II.C.5. Create a multidisciplinary approach	Current	1.9	1.1	4.0	5	10	0	3	0
		Desired	3.6	1.2	4.0	0	1	9	4	5
		Gap	1.7	0.9	3.0	13	4	3	1	0
II.D. Implement the Plan	II.D.1. Utilize knowledge and capability in decision making	Current	1.8	0.6	2.0	8	9	4	0	0
		Desired	3.4	0.7	3.0	0	2	11	5	2
		Gap	1.6	0.4	2.0	7	9	1	0	0
	II.D.2. Foster lean behavior throughout the value stream	Current	1.6	0.6	2.0	10	6	4	0	0
		Desired	3.5	0.9	3.0	0	4	5	10	3
		Gap	1.9	0.8	3.0	11	9	4	1	0
	II.D.3. Align customer requirements and expectations with the extended enterprise	Current	1.8	0.9	3.0	10	5	4	1	0
		Desired	3.5	0.9	3.0	0	1	14	0	5
		Gap	1.7	0.7	4.0	8	11	0	1	0
	II.D.4. Transition product/service in a lean fashion	Current	1.7	0.4	2.0	4	10	2	0	0
		Desired	3.2	0.3	2.0	0	1	12	5	0
		Gap	1.6	0.5	2.0	10	6	2	0	0
II.E. Learn, Improve and Sustain	II.E.1. Enhance value of delivered products and services to customers and the enterprise	Current	1.7	0.4	2.0	12	10	2	0	0
		Desired	3.4	0.9	3.0	0	2	12	1	4
		Gap	1.6	0.8	4.0	4	8	1	1	0
	II.E.2. Provide post delivery service, support and sustainability	Current	1.8	0.7	3.0	5	7	1	1	0
		Desired	3.2	0.9	3.0	0	4	5	5	1
		Gap	1.5	0.3	1.0	5	8	0	0	0
	II.E.3. Maintain challenge of existing processes	Current	1.8	0.6	2.0	7	9	4	0	0
		Desired	3.3	0.7	3.0	0	4	8	7	1
		Gap	1.5	0.4	2.0	6	11	0	0	0

SECTION III - ENABLING INFRASTRUCTURE

								TALLYS		
TTL LINK	**Lean Practice**	State	Mean	Variance	Range	Level 1	Level 2	Level 3	Level 4	Level 5
III.A. Lean Organizational Enablers	III.A.1. Financial system supports lean transformation	Current	1.4	0.3	1.0	8	7	0	0	0
		Desired	2.9	0.8	3.0	0	6	7	3	1
		Gap	1.5	0.5	2.0	8	5	2	0	0
	III.A.2. Enterprise stakeholders pull required financial information	Current	1.6	0.8	3.0	7	5	2	1	0
		Desired	3.2	0.8	3.0	0	4	9	4	2
		Gap	1.6	0.5	2.0	12	7	2	0	0
	III.A.3. Promulgate the learning organization	Current	1.7	0.7	3.0	11	7	2	1	0
		Desired	3.5	1.1	3.0	0	3	9	3	5
		Gap	1.9	0.7	3.0	6	9	3	1	0
	III.A.4. Enable the lean enterprise with information systems and tools	Current	2.1	0.9	3.0	6	9	3	2	0
		Desired	3.8	1.1	3.0	0	2	6	5	6
		Gap	1.8	1.1	3.0	10	5	2	2	0
	III.A.5. Integration of environmental protection, heath and safety into the enterprise	Current	2.0	1.1	4.0	3	7	5	0	1
		Desired	3.4	1.2	4.0	2	3	6	8	3
		Gap	1.4	0.5	2.0	8	11	0	0	0
III.B. Lean Process Enablers	III.B.1. Process standardization	Current	2.0	1.3	3.0	10	3	5	3	0
		Desired	3.5	1.5	4.0	0	4	5	6	5
		Gap	1.6	0.7	4.0	11	10	0	1	0
	III.B.2. Common tools and systems	Current	2.0	1.6	3.0	9	3	1	5	0
		Desired	3.2	1.1	3.0	0	5	8	3	3
		Gap	1.5	0.4	2.0	12	7	1	0	0
	III.B.3. Variation reduction	Current	1.9	0.9	3.0	7	6	4	1	0
		Desired	3.4	1.2	3.0	0	5	4	5	3
		Gap	1.5	0.6	2.0	9	3	3	0	0

APPENDIX H: LEAN GROUP DATA AND ANALYSIS

SECTION 1 - LEAN TRANSFORMATION/LEADERSHIP

	Section X.X Averages		
TTL LINK	Current	Desired	Gap
I.A Enterprise strategic planning	2.8	4.3	1.5
I.B Adopt Lean Paradigm	2.8	4.2	1.4
I.C Focus on the Value Stream	2.7	4.1	1.4
I.D Develop lean Structure and Behavior	2.2	3.9	1.7
I.E Create and Refine Implementation Plan	2.3	3.9	1.6
I.F Implement Lean Initiatives	2.5	3.9	1.4
I.G Focus on Continuous Improvement	2.4	3.9	1.5

SECTION II - LIFE CYCLE PROCESSES

	Section X.X Averages		
TTL LINK	Current	Desired	Gap
II.A. Set-up the Enterprise	2.2	3.6	1.4
II. B. Build Relationships	2.3	3.7	1.4
II.C. Develop the Plan	2.3	3.7	1.4
II.D. Implement the Plan	2.1	3.7	1.6
II.E. Learn, Improve and Sustain	2.3	3.8	1.5

SECTION III - ENABLING INFRASTRUCTURE

	Section X.X Averages		
TTL LINK	Current	Desired	Gap
III.A. Lean Organizational Enablers	2.1	3.7	1.6
III.B. Lean Process Enablers	2.3	3.8	1.5

SECTION 1 - LEAN TRANSFORMATION/LEADERSHIP

							TALLYS			
TTL LINK	**Lean Practice**	**State**	**Mean**	**Variance**	**Range**	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**
I.A Enterprise strategic planning	I.A.1. Integration of lean in strategic planning process	Current	3.5	1.0	4.0	0	4	2	15	1
		Desired	4.8	0.2	1.0	0	0	0	5	18
		Gap	1.3	0.7	4.0	12	3	1	1	0
	I.A.2. Focus on customer value	Current	2.5	0.9	3.0	3	3	13	2	0
		Desired	4.1	0.4	2.0	0	0	3	14	6
		Gap	1.6	0.7	3.0	11	7	2	1	0
	I.A.3. Leveraging the extended enterprise	Current	2.3	1.0	3.0	7	5	10	2	0
		Desired	3.9	0.9	3.0	0	3	3	11	6
		Gap	1.5	0.5	2.0	10	6	3	0	0
I.B Adopt Lean Paradigm	I.B.1. Learning and education in 'lean' for enterprise leaders	Current	3.0	1.0	4.0	0	7	9	5	2
		Desired	4.3	0.5	2.0	0	0	4	10	10
		Gap	1.3	0.5	3.0	18	4	2	0	0
	I.B.2. Senior management commitment	Current	2.9	1.5	4.0	6	2	6	4	1
		Desired	4.0	0.9	3.0	0	2	1	8	5
		Gap	1.1	0.5	3.0	16	2	1	0	0
	I.B.3 Lean Enterprise Vision	Current	2.6	0.9	3.0	4	9	7	5	0
		Desired	4.1	0.7	3.0	0	1	4	10	9
		Gap	1.5	0.8	3.0	18	7	0	2	0
	I.B.4. A sense of urgency	Current	2.8	1.0	4.0	3	5	12	3	1
		Desired	4.3	0.5	2.0	0	0	3	10	11
		Gap	1.6	0.8	4.0	12	8	2	1	0
I.C Focus on the Value Stream	I.C.1. Understanding the current value stream	Current	2.7	0.7	3.0	4	4	14	2	0
		Desired	4.0	0.8	3.0	0	1	5	9	8
		Gap	1.4	0.6	4.0	12	7	0	1	0
	I.C.2. Enterprise flow	Current	2.5	0.5	3.0	0	11	9	1	0
		Desired	3.9	0.8	3.0	0	1	6	9	6
		Gap	1.5	0.5	2.0	13	6	2	0	0
	I.C.3. Designing the future value stream	Current	2.3	1.0	4.0	5	10	7	1	1
		Desired	4.0	0.6	2.0	0	0	7	9	7
		Gap	1.7	1.2	4.0	13	5	1	3	0
	I.C.4. Performance measures	Current	3.4	1.2	4.0	1	2	7	10	3
		Desired	4.6	0.3	2.0	0	0	1	8	15
		Gap	1.2	0.8	4.0	12	3	1	1	0
I.D Develop lean Structure and Behavior	I.D.1. Enterprise organizational orientation	Current	2.6	0.8	3.0	2	6	11	3	0
		Desired	4.0	0.6	3.0	0	1	4	12	6
		Gap	1.4	0.9	3.0	16	1	1	2	0
	I.D.2. Relationships based on mutual trust	Current	2.3	1.0	3.0	7	7	7	3	0
		Desired	4.0	0.8	3.0	0	1	6	9	7
		Gap	1.7	1.0	3.0	13	5	2	2	0
	I.D.3. Open and timely communications	Current	2.6	0.9	3.0	4	7	10	4	0
		Desired	4.2	0.5	2.0	0	0	4	11	9
		Gap	1.6	0.8	3.0	12	8	0	2	0
	I.D.4. Employee empowerment	Current	2.3	1.2	3.0	9	4	8	3	0
		Desired	3.9	0.8	3.0	0	2	5	10	6
		Gap	1.6	0.7	3.0	11	7	2	1	0
	I.D.5. Incentive alignment	Current	1.6	0.5	2.0	18	7	3	0	0
		Desired	3.6	0.9	3.0	0	2	10	6	5
		Gap	2.0	1.0	3.0	2	8	5	2	0
	I.D.6. Innovation encouragement	Current	1.7	0.6	2.0	10	8	4	0	0
		Desired	3.7	1.1	3.0	0	3	6	7	6
		Gap	2.0	1.0	3.0	6	8	4	2	0
	I.D.7. Lean change agents	Current	2.0	0.5	3.0	2	14	2	1	0
		Desired	3.8	0.6	2.0	0	0	9	8	4
		Gap	1.8	0.5	2.0	8	10	3	0	0
I.E Create and Refine Implementation Plan	I.E.1. Enterprise level lean implementation plan	Current	2.5	0.6	3.0	1	7	12	1	0
		Desired	3.8	0.6	3.0	0	1	6	12	4
		Gap	1.3	1.0	4.0	14	4	0	2	0
	I.E.2. Commit resources for lean improvements	Current	2.3	0.6	3.0	2	10	9	1	0
		Desired	3.8	0.8	3.0	0	1	8	8	6
		Gap	1.5	0.4	2.0	13	7	2	0	0
	I.E.3. Provide education and training	Current	2.1	0.7	3.0	7	10	7	1	0
		Desired	4.0	0.9	3.0	0	1	8	6	9
		Gap	1.8	1.0	3.0	9	6	4	2	0
I.F Implement Lean Initiatives	I.F.1. Development of detailed plans based on enterprise plan	Current	2.2	0.8	3.0	6	11	6	2	0
		Desired	3.5	1.1	4.0	1	3	7	9	4
		Gap	1.3	0.6	3.0	12	5	2	0	0
	I.F.2. Tracking detailed implementation	Current	2.8	0.9	4.0	4	3	15	2	1
		Desired	4.3	0.5	3.0	0	1	1	13	9
		Gap	1.5	0.6	3.0	9	9	2	0	0
I.G Focus on Continuous Improvement	I.G.1. Structured continuous improvement process	Current	2.5	0.5	3.0	0	13	8	2	0
		Desired	4.0	0.5	2.0	0	0	5	13	6
		Gap	1.6	0.7	3.0	11	7	2	1	0
	I.G.2. Monitoring lean progress	Current	2.8	0.6	3.0	0	10	11	2	1
		Desired	4.1	0.5	2.0	0	0	5	11	8
		Gap	1.4	0.4	3.0	12	8	1	0	0
	I.G.3. Nurturing the process	Current	2.3	0.8	4.0	4	14	5	1	1
		Desired	3.7	1.0	3.0	0	2	10	5	7
		Gap	1.4	0.4	3.0	9	9	1	0	0
	I.G.4. Capturing lessons learned	Current	2.0	0.7	3.0	5	11	5	1	0
		Desired	3.8	0.6	2.0	0	0	9	9	5
		Gap	1.8	0.9	3.0	11	8	2	2	0
	I.G.5. Impacting enterprise strategic planning	Current	2.5	0.5	3.0	0	12	8	2	0
		Desired	3.9	0.8	3.0	0	2	4	12	5
		Gap	1.4	0.3	2.0	10	10	0	0	0

SECTION II - LIFE CYCLE PROCESSES

								TALLYS		
TTL LINK	**Lean Practice**	State	Mean	Variance	Range	Level 1	Level 2	Level 3	Level 4	Level 5
II.A. Set-up the Enterprise	II.A.1. Leverage lean capability for new opportunities	Current	2.1	0.7	2.0	6	8	9	0	0
		Desired	3.4	0.8	3.0	0	4	7	10	2
		Gap	1.3	0.2	1.0	14	7	0	0	0
	II.A.2. Optimise the capability and utilization of assets	Current	2.1	0.8	3.0	4	12	4	2	0
		Desired	3.5	1.0	3.0	0	4	7	8	4
		Gap	1.4	0.8	4.0	10	6	1	1	0
	II.A.3. Provide capability to manage risk, cost, schedule and performance	Current	2.2	0.8	3.0	4	13	3	3	0
		Desired	3.7	0.7	3.0	0	1	9	8	5
		Gap	1.5	1.0	4.0	11	8	0	2	0
	II.A.4. Allocate resources for program/project development efforts	Current	2.3	0.7	3.0	1	8	10	1	0
		Desired	3.6	0.7	3.0	0	3	6	12	2
		Gap	1.2	0.2	1.0	17	5	0	0	0
II. B. Build Relationships	II.B.1. Define and develop relationships with stakeholders	Current	2.5	0.7	3.0	3	8	9	2	0
		Desired	3.9	0.5	2.0	0	0	7	11	4
		Gap	1.4	0.4	3.0	8	8	1	0	0
	II.B.2. Optimize the relationship	Current	2.5	0.7	3.0	3	6	11	2	0
		Desired	3.9	0.6	2.0	0	0	7	10	5
		Gap	1.4	0.8	4.0	9	5	1	1	0
	II.B.3. Foster innovation and knowledge-sharing	Current	2.0	0.7	3.0	4	13	3	2	0
		Desired	3.5	0.9	3.0	0	3	11	6	4
		Gap	1.4	0.5	3.0	15	7	0	1	0
II.C. Develop the Plan	II.C.1. Establish a requirements definition process to optimize life cycle value	Current	2.4	0.9	3.0	3	11	3	4	0
		Desired	3.8	0.7	2.0	0	0	9	7	5
		Gap	1.4	0.4	2.0	9	7	1	0	0
	II.C.2. Capture data from the extended enterprise to optimize future requirement definitions	Current	2.7	1.2	4.0	5	4	10	3	1
		Desired	4.0	0.7	2.0	0	0	7	8	7
		Gap	1.3	0.5	3.0	12	7	1	0	0
	II.C.3. Incorporate stakeholder value into design of products and processes	Current	2.2	0.7	3.0	3	13	3	2	0
		Desired	3.5	0.7	3.0	0	3	8	9	2
		Gap	1.3	0.3	2.0	11	7	0	0	0
	II.C.4. Incorporate downstream stakeholder values into products and processes	Current	2.3	1.2	3.0	6	11	2	5	0
		Desired	3.7	0.9	3.0	0	2	10	6	6
		Gap	1.4	0.6	3.0	11	5	3	0	0
	II.C.5. Create a multidisciplinary approach	Current	2.0	0.4	2.0	4	12	4	0	0
		Desired	3.5	1.0	3.0	0	3	8	6	4
		Gap	1.6	1.2	4.0	8	3	4	1	0
II.D. Implement the Plan	II.D.1. Utilize knowledge and capability in decision making	Current	2.0	0.8	3.0	5	7	6	1	0
		Desired	3.8	0.9	3.0	0	3	3	11	4
		Gap	1.7	0.7	3.0	5	8	4	0	0
	II.D.2. Foster lean behavior throughout the value stream	Current	2.3	0.5	3.0	4	13	7	1	0
		Desired	3.7	0.6	3.0	0	1	8	12	3
		Gap	1.5	0.7	3.0	9	7	3	0	0
	II.D.3. Align customer requirements and expectations with the extended enterprise	Current	2.2	0.7	3.0	5	10	7	1	0
		Desired	3.6	0.3	2.0	0	0	9	12	1
		Gap	1.4	0.4	2.0	11	5	2	0	0
	II.D.4. Transition product/service in a lean fashion	Current	1.8	0.6	2.0	8	9	4	0	0
		Desired	3.6	0.7	3.0	0	2	7	9	3
		Gap	1.8	1.1	4.0	8	8	2	2	0
II.E. Learn, Improve and Sustain	II.E.1. Enhance value of delivered products and services to customers and the enterprise	Current	2.3	0.5	2.0	1	9	10	0	0
		Desired	3.7	0.6	3.0	0	1	8	10	3
		Gap	1.4	0.3	2.0	13	6	1	0	0
	II.E.2. Provide post delivery service, support and sustainability	Current	2.3	0.6	2.0	4	7	10	0	0
		Desired	4.0	0.8	3.0	0	1	6	7	7
		Gap	1.7	0.8	4.0	9	8	2	1	0
	II.E.3. Maintain challenge of existing processes	Current	2.2	0.5	3.0	3	13	6	1	0
		Desired	3.7	0.5	2.0	0	0	9	11	3
		Gap	1.5	0.6	3.0	15	7	1	1	0

SECTION III - ENABLING INFRASTRUCTURE

								TALLYS		
TTL LINK	**Lean Practice**	State	Mean	Variance	Range	Level 1	Level 2	Level 3	Level 4	Level 5
III.A. Lean Organizational Enablers	III.A.1. Financial system supports lean transformation	Current	2.0	0.9	3.0	8	9	2	2	0
		Desired	3.6	1.1	3.0	0	3	8	4	5
		Gap	1.6	1.0	4.0	6	7	0	2	0
	III.A.2. Enterprise stakeholders pull required financial information	Current	1.9	0.3	2.0	5	14	2	0	0
		Desired	3.6	0.8	3.0	0	1	11	4	4
		Gap	1.7	0.9	4.0	6	7	2	1	0
	III.A.3. Promulgate the learning organization	Current	2.0	0.8	3.0	5	8	5	1	0
		Desired	3.6	0.7	3.0	0	1	10	6	4
		Gap	1.6	0.6	3.0	8	8	1	1	0
	III.A.4. Enable the lean enterprise with information systems and tools	Current	2.3	0.9	3.0	2	13	1	4	0
		Desired	3.9	0.7	3.0	0	1	5	10	5
		Gap	1.6	0.8	4.0	7	7	2	1	0
	III.A.5. Integration of environmental protection, heath and safety into the enterprise	Current	2.3	0.9	3.0	7	3	11	1	0
		Desired	3.9	1.3	3.0	0	3	5	4	9
		Gap	1.6	1.2	4.0	9	6	1	2	0
III.B. Lean Process Enablers	III.B.1. Process standardization	Current	2.5	1.1	3.0	6	9	5	5	0
		Desired	3.8	0.9	3.0	0	2	6	9	6
		Gap	1.3	0.5	3.0	8	8	1	0	0
	III.B.2. Common tools and systems	Current	2.5	1.0	3.0	3	8	6	4	0
		Desired	4.0	0.8	3.0	0	1	5	9	7
		Gap	1.5	0.9	3.0	11	4	1	2	0
	III.B.3. Variation reduction	Current	2.0	0.8	3.0	8	10	3	2	0
		Desired	3.5	0.7	3.0	0	2	8	9	2
		Gap	1.5	0.4	2.0	7	8	1	0	0

APPENDIX I: GLESAT ANALYSIS FOR NON-LEAN GROUP

*Highlighted cells are high priority practices

Practice	Current State	Variance	Gap	Interpretation	Recommendation
I.A.1. Integration of lean in strategic planning process	1.10	0.70	2.20	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve
I.A.2. Focus on customer value	1.95	0.85	1.81	Opportunity to close the gap through improvements	Discuss practice and take action to improve
I.A.3. Leveraging the extended enterprise	2.10	1.04	1.60	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
I.B.1. Learning and education in 'lean' for enterprise leaders	1.77	0.56	1.45	Practice can be improved but is not of high priority to the organization	Maintain or improve
I.B.2. Senior management commitment	1.20	0.60	2.00	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve
I.B.3 Lean Enterprise Vision	1.00	0.30	2.10	Weak area with strong agreement of the current state of the practice. There is opportunity to close the gap through lean improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
I.B.4. A sense of urgency	1.05	0.52	1.86	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve

(Appendix 7.9 continued)

Practice	Current State	Variance	Gap	Interpretation	Recommendation
I.C.1. Understanding the current value stream	1.45	0.58	1.60	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve
I.C.2. Enterprise flow	1.91	0.85	1.50	Practice can be improved but is not of high priority to the organization	Maintain or improve
I.C.3. Designing the future value stream	1.50	0.93	1.64	Opportunity to close the gap through improvements	Discuss practice and take action to improve
I.C.4. Performance measures	1.86	1.17	1.76	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
I.D.1. Enterprise organizational orientation	2.05	0.90	1.59	Opportunity to close the gap through improvements	Discuss practice and take action to improve
I.D.2. Relationships based on mutual trust	1.64	1.00	1.95	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
I.D.3. Open and timely communications	2.18	1.11	1.68	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents

(Appendix 7.9 continued)

Practice	Current State	Variance	Gap	Interpretation	Recommendation
I.D.4. Employee empowerment	2.41	1.21	1.52	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
I.D.5. Incentive alignment	1.80	0.90	2.10	Opportunity to close the gap through improvements	Discuss practice and take action to improve
I.D.6. Innovation encouragement	1.76	0.89	1.81	Opportunity to close the gap through improvements	Discuss practice and take action to improve
I.D.7. Lean change agents	1.25	0.83	1.70	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve
I.E.1. Enterprise level lean implementation plan	1.48	0.66	1.60	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve
I.E.2. Commit resources for lean improvements	1.52	0.56	1.95	Opportunity to close the gap through improvements	Discuss practice and take action to improve
I.E.3. Provide education and training	1.45	0.55	1.81	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve
I.F.1. Development of detailed plans based on enterprise plan	1.33	0.53	1.67	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve
I.F.2. Tracking detailed implementation	1.28	0.57	1.72	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve

(Appendix 7.9 continued)

Practice	Current State	Variance	Gap	Interpretation	Recommendation
I.G.1. Structured continuous improvement process	1.81	0.86	1.48	Practice can be improved but is not of high priority to the organization	Maintain or improve
I.G.2. Monitoring lean progress	1.70	1.06	1.53	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
I.G.3. Nurturing the process	1.50	0.60	2.00	Opportunity to close the gap through improvements	Discuss practice and take action to improve
I.G.4. Capturing lessons learned	1.85	1.29	1.90	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
I.G.5. Impacting enterprise strategic planning	1.32	0.89	1.74	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve
II.A.1. Leverage lean capability for new opportunities	1.48	0.46	1.57	Weak area with strong agreement of the current state of the practice. There is opportunity to close the gap through lean improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
II.A.2. Optimize the capability and utilization of assets	1.68	0.61	1.59	Opportunity to close the gap through improvements	Discuss practice and take action to improve

(Appendix 7.9 continued)

Practice	Current State	Variance	Gap	Interpretation	Recommendation
II.A.3. Provide capability to manage risk, cost, schedule and performance	1.71	1.01	1.52	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
II.A.4. Allocate resources for program/project development efforts	2.05	0.85	1.67	Opportunity to close the gap through improvements	Discuss practice and take action to improve
II.B.1. Define and develop relationships with stakeholders	1.95	1.00	1.73	Opportunity to close the gap through improvements	Discuss practice and take action to improve
II.B.2. Optimize the relationship	2.23	0.47	1.45	Practice can be improved but is not of high priority to the organization	Maintain or improve
II.B.3. Foster innovation and knowledge-sharing	1.86	0.53	1.67	Opportunity to close the gap through improvements	Discuss practice and take action to improve
II.C.1. Establish a requirements definition process to optimize life cycle value	1.74	0.87	1.42	Practice can be improved but is not of high priority to the organization	Maintain or improve
II.C.2. Capture data from the extended enterprise to optimize future requirement definitions	2.06	0.93	1.63	Opportunity to close the gap through improvements	Discuss practice and take action to improve

(Appendix 7.9 continued)

Practice	Current State	Variance	Gap	Interpretation	Recommendation
II.C.3. Incorporate stakeholder value into design of products and processes	1.53	0.49	1.58	Strong agreement in the area. Opportunity to close the gap through improvement initiatives	Discuss practice and take action to improve
II.C.4. Incorporate downstream stakeholder values into products and processes	2.14	0.29	1.64	Strong agreement in the area. Opportunity to close the gap through improvement initiatives	Discuss practice and take action to improve
II.C.5. Create a multidisciplinary approach	1.90	1.15	1.65	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
II.D.1. Utilize knowledge and capability in decision making	1.81	0.56	1.55	Opportunity to close the gap through improvements	Discuss practice and take action to improve
II.D.2. Foster lean behavior throughout the value stream	1.64	0.62	1.91	Opportunity to close the gap through improvements	Discuss practice and take action to improve
II.D.3. Align customer requirements and expectations with the extended enterprise	1.80	0.91	1.65	Opportunity to close the gap through improvements	Discuss practice and take action to improve
II.D.4. Transition product/service in a lean fashion	1.74	0.43	1.56	Strong agreement in the area. Opportunity to close the gap through improvement initiatives	Discuss practice and take action to improve

(Appendix 7.9 continued)

Practice	Current State	Variance	Gap	Interpretation	Recommendation
II.E.1. Enhance value of delivered products and services to customers and the enterprise	1.70	0.43	1.63	Strong agreement in the area. Opportunity to close the gap through improvement initiatives	Discuss practice and take action to improve
II.E.2. Provide post delivery service, support and sustainability	1.75	0.73	1.53	Opportunity to close the gap through improvements	Discuss practice and take action to improve
II.E.3. Maintain challenge of existing processes	1.81	0.56	1.50	Practice can be improved but is not of high priority to the organization	Maintain or improve
III.A.1. Financial system supports lean transformation	1.41	0.26	1.53	Weak area with strong agreement of the current state of the practice. There is opportunity to close the gap through lean improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
III.A.2. Enterprise stakeholders pull required financial information	1.63	0.80	1.58	Opportunity to close the gap through improvements	Discuss practice and take action to improve
III.A.3. Promulgate the learning organization	1.67	0.73	1.90	Opportunity to close the gap through improvements	Discuss practice and take action to improve
III.A.4. Enable the lean enterprise with information systems and tools	2.05	0.89	1.79	Opportunity to close the gap through improvements	Discuss practice and take action to improve

(Appendix 7.9 continued)

Practice	Current State	Variance	Gap	Interpretation	Recommendation
III.A.5. Integration of environmental protection, health and safety into the enterprise	2.00	1.10	1.43	Area with high disagreement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
III.B.1. Process standardization	2.00	1.33	1.57	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
III.B.2. Common tools and systems	1.95	1.65	1.47	Area with high disagreement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
III.B.3. Variation reduction	1.94	0.88	1.53	Opportunity to close the gap through improvements	Discuss practice and take action to improve

APPENDIX J: GLESAT ANALYSIS FOR LEAN GROUP

*Highlighted cells are high priority practices

Practice	Current State	Variance	Gap	Interpretation	Recommendation
I.A.1. Integration of lean in strategic planning process	3.48	0.98	1.30	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve
I.A.2. Focus on customer value	2.52	0.90	1.61	Opportunity to close the gap through improvements	Discuss practice and take action to improve
I.A.3. Leveraging the extended enterprise	2.35	0.96	1.52	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
I.B.1. Learning and education in 'lean' for enterprise leaders	3.00	1.04	1.25	Practice can be improved but is not of high priority to the organization	Maintain or improve
I.B.2. Senior management commitment	2.88	1.45	1.13	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve
I.B.3 Lean Enterprise Vision	2.58	0.95	1.54	Weak area with strong agreement of the current state of the practice. There is opportunity to close the gap through lean improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
I.B.4. A sense of urgency	2.75	0.98	1.58	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve

(Appendix 7.10 continued)

Practice	Current State	Variance	Gap	Interpretation	Recommendation
I.C.1. Understanding the current value stream	2.65	0.69	1.39	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve
I.C.2. Enterprise flow	2.45	0.45	1.45	Practice can be improved but is not of high priority to the organization	Maintain or improve
I.C.3. Designing the future value stream	2.35	0.96	1.65	Opportunity to close the gap through improvements	Discuss practice and take action to improve
I.C.4. Performance measures	3.42	1.21	1.17	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
I.D.1. Enterprise organizational orientation	2.61	0.79	1.39	Opportunity to close the gap through improvements	Discuss practice and take action to improve
I.D.2. Relationships based on mutual trust	2.30	1.04	1.65	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
I.D.3. Open and timely communications	2.63	0.85	1.58	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents

(Appendix 7.10 continued)

Practice	Current State	Variance	Gap	Interpretation	Recommendation
I.D.4. Employee empowerment	2.26	1.20	1.61	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
I.D.5. Incentive alignment	1.60	0.50	2.00	Opportunity to close the gap through improvements	Discuss practice and take action to improve
I.D.6. Innovation encouragement	1.60	0.58	2.00	Opportunity to close the gap through improvements	Discuss practice and take action to improve
I.D.7. Lean change agents	2.00	0.50	1.76	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve
I.E.1. Enterprise level lean implementation plan	2.48	0.62	1.35	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve
I.E.2. Commit resources for lean improvements	2.35	0.60	1.48	Opportunity to close the gap through improvements	Discuss practice and take action to improve
I.E.3. Provide education and training	2.13	0.72	1.83	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve
I.F.1. Development of detailed plans based on enterprise plan	2.21	0.78	1.29	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve
I.F.2. Tracking detailed implementation	2.79	0.87	1.46	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve

(Appendix 7.10 continued)

Practice	Current State	Variance	Gap	Interpretation	Recommendation
I.G.1. Structured continuous improvement process	2.46	0.52	1.58	Practice can be improved but is not of high priority to the organization	Maintain or improve
I.G.2. Monitoring lean progress	2.75	0.63	1.38	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
I.G.3. Nurturing the process	2.29	0.82	1.42	Opportunity to close the gap through improvements	Discuss practice and take action to improve
I.G.4. Capturing lessons learned	2.04	0.68	1.78	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
I.G.5. Impacting enterprise strategic planning	2.48	0.53	1.39	Weak area with opportunity to close gap through improvement	Discuss practice and take action to improve
II.A.1. Leverage lean capability for new opportunities	2.13	0.66	1.30	Weak area with strong agreement of the current state of the practice. There is opportunity to close the gap through lean improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
II.A.2. Optimize the capability and utilization of assets	2.13	0.75	1.39	Opportunity to close the gap through improvements	Discuss practice and take action to improve

(Appendix 7.10 continued)

Practice	Current State	Variance	Gap	Interpretation	Recommendation
II.A.3. Provide capability to manage risk, cost, schedule and performance	2.22	0.81	1.52	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
II.A.4. Allocate resources for program/project development efforts	2.35	0.69	1.22	Opportunity to close the gap through improvements	Discuss practice and take action to improve
II.B.1. Define and develop relationships with stakeholders	2.45	0.74	1.41	Opportunity to close the gap through improvements	Discuss practice and take action to improve
II.B.2. Optimize the relationship	2.55	0.74	1.36	Practice can be improved but is not of high priority to the organization	Maintain or improve
II.B.3. Foster innovation and knowledge-sharing	2.04	0.74	1.42	Opportunity to close the gap through improvements	Discuss practice and take action to improve
II.C.1. Establish a requirements definition process to optimize life cycle value	2.38	0.95	1.43	Practice can be improved but is not of high priority to the organization	Maintain or improve
II.C.2. Capture data from the extended enterprise to optimize future requirement definitions	2.68	1.18	1.32	Opportunity to close the gap through improvements	Discuss practice and take action to improve

(Appendix 7.10 continued)

Practice	Current State	Variance	Gap	Interpretation	Recommendation
II.C.3. Incorporate stakeholder value into design of products and processes	2.19	0.66	1.29	Strong agreement in the area. Opportunity to close the gap through improvement initiatives	Discuss practice and take action to improve
II.C.4. Incorporate downstream stakeholder values into products and processes	2.25	1.15	1.42	Strong agreement in the area. Opportunity to close the gap through improvement initiatives	Discuss practice and take action to improve
II.C.5. Create a multidisciplinary approach	1.95	0.45	1.57	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
II.D.1. Utilize knowledge and capability in decision making	2.05	0.85	1.71	Opportunity to close the gap through improvements	Discuss practice and take action to improve
II.D.2. Foster lean behavior throughout the value stream	2.25	0.54	1.46	Opportunity to close the gap through improvements	Discuss practice and take action to improve
II.D.3. Align customer requirements and expectations with the extended enterprise	2.23	0.66	1.41	Opportunity to close the gap through improvements	Discuss practice and take action to improve
II.D.4. Transition product/service in a lean fashion	1.81	0.56	1.81	Strong agreement in the area. Opportunity to close the gap through improvement initiatives	Discuss practice and take action to improve

(Appendix 7.10 continued)

Practice	Current State	Variance	Gap	Interpretation	Recommendation
II.E.1. Enhance value of delivered products and services to customers and the enterprise	2.32	0.51	1.36	Strong agreement in the area. Opportunity to close the gap through improvement initiatives	Discuss practice and take action to improve
II.E.2. Provide post delivery service, support and sustainability	2.29	0.61	1.67	Opportunity to close the gap through improvements	Discuss practice and take action to improve
II.E.3. Maintain challenge of existing processes	2.22	0.54	1.52	Practice can be improved but is not of high priority to the organization	Maintain or improve
III.A.1. Financial system supports lean transformation	1.95	0.89	1.60	Weak area with strong agreement of the current state of the practice. There is opportunity to close the gap through lean improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
III.A.2. Enterprise stakeholders pull required financial information	1.90	0.31	1.65	Opportunity to close the gap through improvements	Discuss practice and take action to improve
III.A.3. Promulgate the learning organization	2.00	0.80	1.62	Opportunity to close the gap through improvements	Discuss practice and take action to improve
III.A.4. Enable the lean enterprise with information systems and tools	2.29	0.91	1.62	Opportunity to close the gap through improvements	Discuss practice and take action to improve

(Appendix 7.10 continued)

Practice	Current State	Variance	Gap	Interpretation	Recommendation
III.A.5. Integration of environmental protection, health and safety into the enterprise	2.33	0.93	1.57	Area with high disagreement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
III.B.1. Process standardization	2.48	1.08	1.35	Practice with disagreement. Opportunity to close the gap through improvement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
III.B.2. Common tools and systems	2.45	1.02	1.55	Area with high disagreement	Practice needs further open discussion or may benefit from additional training to create better alignment between respondents
III.B.3. Variation reduction	2.05	0.85	1.48	Opportunity to close the gap through improvements	Discuss practice and take action to improve

APPENDIX K: SWOT DISTRIBUTION FOR PRACTICES OF NON-LEAN PROGRAM

Strength	Weakness	Opportunity	Threat (High Priority)
I.A.3. Leveraging the extended enterprise	I.C.1. Understanding the current value stream	I.A.2. Focus on customer value	I.A.1. Integration of lean in strategic planning process
I.C.2. Enterprise flow	I.C.3. Designing the future value stream	I.C.4. Performance measures	I.B.2. Senior management commitment
I.D.1. Enterprise organizational orientation	I.E.1. Enterprise level lean implementation plan	I.D.5. Incentive alignment	I.B.3 Lean Enterprise Vision
I.D.3. Open and timely communications	I.F.1. Development of detailed plans based on enterprise plan	I.D.6. Innovation encouragement	I.B.4. A sense of urgency
I.G.1. Structured continuous improvement process	I.G.2. Monitoring lean progress	I.G.4. Capturing lessons learned	I.D.2. Relationships based on mutual trust
II.A.4. Allocate resources for program/project development efforts	II.A.1. Leverage lean capability for new opportunities	II.B.1. Define and develop relationships with stakeholders	I.D.4. Employee empowerment
II.B.2. Optimize the relationship	II.A.2. Optimize the capability and utilization of assets	III.A.4. Enable the lean enterprise with information systems and tools	I.D.7. Lean change agents
II.B.3. Foster innovation and knowledge-sharing	II.A.3. Provide capability to manage risk, cost, schedule and performance		I.E.2. Commit resources for lean improvements
II.C.1. Establish a requirements definition process to optimize life cycle value	II.C.3. Incorporate stakeholder value into design of products and processes		I.E.3. Provide education and training
II.C.2. Capture data from the extended enterprise to optimize future requirement definitions	II.E.1. Enhance value of delivered products and services to customers and the enterprise		I.F.2. Tracking detailed implementation
II.C.4. Incorporate downstream stakeholder values into products and processes	III.A.1. Financial system supports lean transformation		I.G.3. Nurturing the process
II.C.5. Create a multidisciplinary	III.A.2. Enterprise stakeholders pull		I.G.5. Impacting enterprise strategic

approach	required financial information		planning

(Appendix 7.11 continued)

Strength	Weakness	Opportunity	Threat (High Priority)
II.D.1. Utilize knowledge and capability in decision making			II.D.2. Foster lean behavior throughout the value stream
II.D.3. Align customer requirements and expectations with the extended enterprise			III.A.3. Promulgate the learning organization
II.D.4. Transition product/service in a lean fashion			
II.E.2. Provide post delivery service, support and sustainability			
II.E.3. Maintain challenge of existing processes			
III.A.4. Enable the lean enterprise with information systems and tools			
III.A.5. Integration of environmental protection, health and safety into the enterprise			
III.B.1. Process standardization			
III.B.2. Common tools and systems			
III.B.3. Variation reduction			

APPENDIX L: SWOT DISTRIBUTION FOR PRACTICES OF LEAN PROGRAM

Strength	Weakness	Opportunity	Threat (High Priority)
I.A.1. Integration of lean in strategic planning process	I.E.2. Commit resources for lean improvements	I.A.2. Focus on customer value	I.D.5. Incentive alignment
I.B.1. Learning and education in 'lean' for enterprise leaders	I.F.1. Development of detailed plans based on enterprise plan	I.B.3 Lean Enterprise Vision	I.D.6. Innovation encouragement
I.B.2. Senior management commitment	I.G.3. Nurturing the process	I.B.4. A sense of urgency	I.D.7. Lean change agents
I.C.1. Understanding the current value stream	II.A.1. Leverage lean capability for new opportunities	I.D.3. Open and timely communications	I.E.3. Provide education and training
I.C.2. Enterprise flow	II.A.2. Optimize the capability and utilization of assets	I.G.1. Structured continuous improvement process	I.G.4. Capturing lessons learned
I.C.4. Performance measures	II.A.4. Allocate resources for program/project development efforts	III.B.2. Common tools and systems	II.C.5. Create a multidisciplinary approach
I.D.1. Enterprise organizational orientation	II.B.3. Foster innovation and knowledge-sharing	I.A.3. Leveraging the extended enterprise	II.D.4. Transition product/service in a lean fashion
I.E.1. Enterprise level lean implementation plan	II.C.3. Incorporate stakeholder value into design of products and processes	I.C.3. Designing the future value stream	II.E.2. Provide post delivery service, support and sustainability
I.F.2. Tracking detailed implementation	II.C.4. Incorporate downstream stakeholder values into products and processes	I.D.2. Relationships based on mutual trust	II.E.3. Maintain challenge of existing processes
I.G.2. Monitoring lean progress	II.D.2. Foster lean behavior throughout the value stream	I.D.4. Employee empowerment	III.A.2. Enterprise stakeholders pull required financial information
I.G.5. Impacting enterprise strategic planning	II.D.3. Align customer requirements and expectations with the extended enterprise	II.A.3. Provide capability to manage risk, cost, schedule and performance	
II.B.1. Define and develop relationships with stakeholders	II.E.1. Enhance value of delivered products and services to customers and the enterprise	II.D.1. Utilize knowledge and capability in decision making	

(Appendix 7.12 continued)

Strength	Weakness	Opportunity	Threat (High Priority)
II.B.2. Optimize the relationship	III.B.3. Variation reduction	III.A.1. Financial system supports lean transformation	
II.C.1. Establish a requirements definition process to optimize life cycle value		III.A.3. Promulgate the learning organization	
II.C.2. Capture data from the extended enterprise to optimize future requirement definitions		III.A.4. Enable the lean enterprise with information systems and tools	
III.B.1. Process standardization		III.A.5. Integration of environmental protection, health and safety into the enterprise	

VITA

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